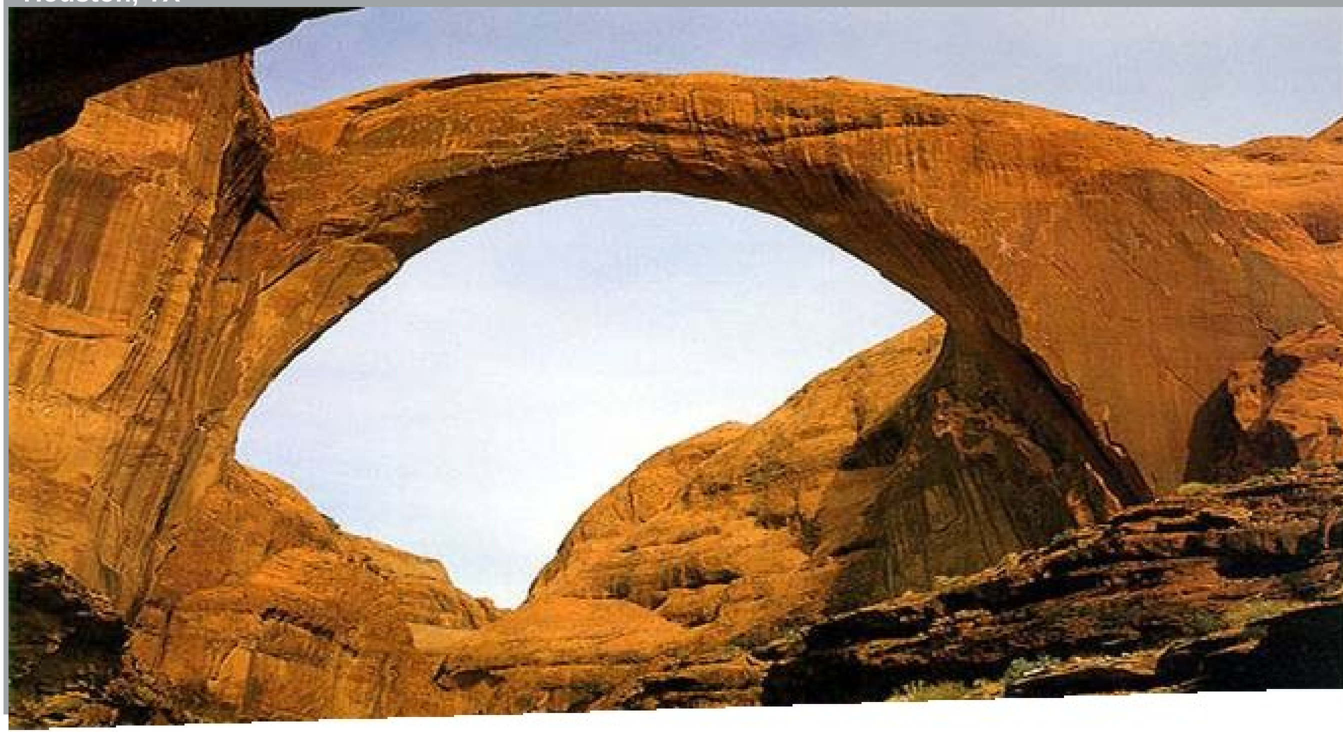
Prepared for:
Sithe Global Power, LLC
Houston, TX



Desert Rock Energy Facility Application for Prevention of Significant Deterioration Permit – Class I Area Modeling Update

ENSR Corporation
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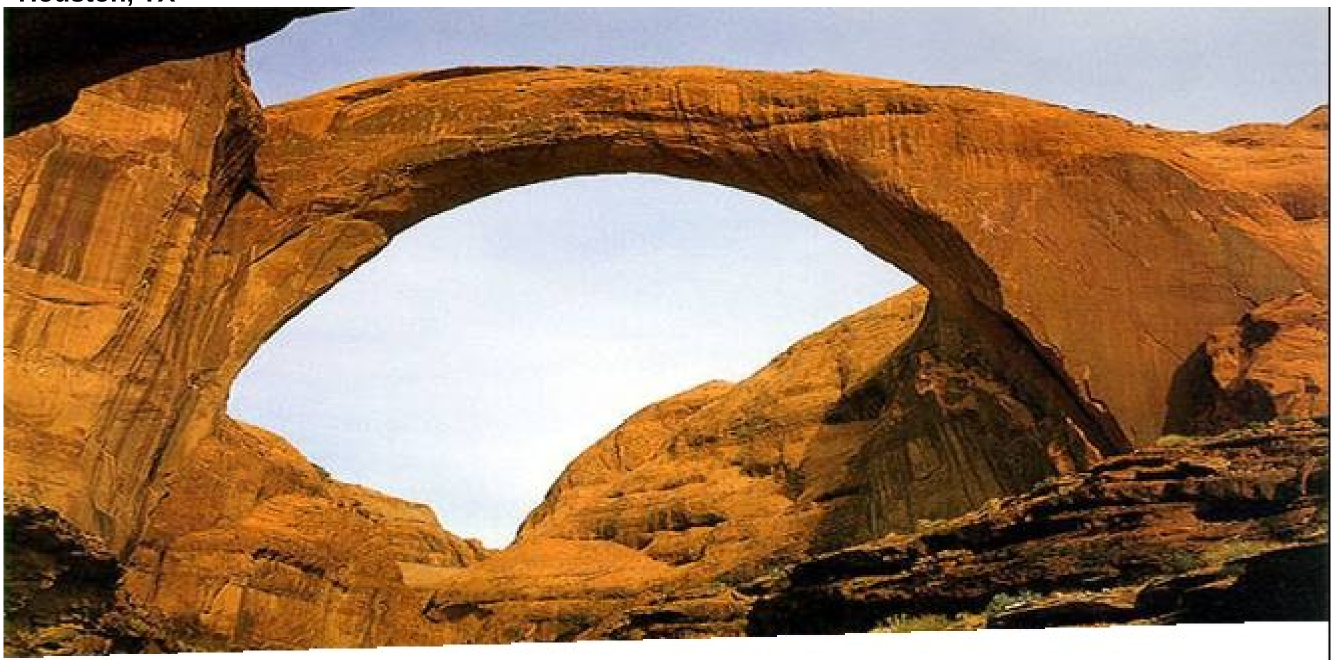

Desert Rock Energy Facility Application for Prevention of Significant Deterioration Permit – Class I Area Modeling Update

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1.0 Introduction

1.1 Project overview

Diné Power Authority (DPA), a Navajo Nation Enterprise, has entered into a development agreement with Sithe Global Power, LLC ("Sithe Global", formerly Steag Power, LLC) to develop an electric power generation facility on Navajo Nation trust land. The Desert Rock Energy Facility, the "Project", will further support the Navajo Nation by utilizing the Navajo Nation coal reserves from the nearby mine operated by BHP Billiton. Sithe Global and DPA have a shared vision to develop an environmentally friendly project that efficiently uses the Navajo resources and brings substantial benefits to the Navajo Nation and surrounding communities.

Sithe Global has taken a holistic approach to the development and design of this facility to incorporate high efficiency with effective emission controls. Sithe Global proposes to use their connections with German experience and proprietary knowledge to design and build a state-of-the-art, mine-mouth coal-fired power plant, and at the same time improve environmental protection, efficiency, and reliability of large coal-fired power plants. The Project will consist of a green-field power plant that will use two supercritical pulverized coal boilers, paired with steam turbines, and will be designed for a total generation capacity of 1,500 MW (gross). The facility will also include three auxiliary boilers, two emergency diesel generators, two diesel firewater pumps, and all of the auxiliary equipment necessary to support the green-field power facility. This equipment will generate substantial power with efficient use of the Navajo Nation coal resource and a minimum of air quality impacts.

The Project will include two dry natural draft Heller cooling tower systems to preserve the critical water resources in the region. Water for plant maintenance will be supplied by the Navajo Nation under a water rights permit. This facility has been designed to optimize the use of water for power generation and to maximize efficiency of the plant operations.

Since the proposed facility will be a "major source" of criteria air pollutants, Sithe Global applied to EPA Region 9 (administrator for the Navajo Nation) for a Prevention of Significant Deterioration (PSD) permit in May, 2004. The permit application was determined to be complete by EPA Region 9 in June, 2004. There were several comments on the Class I area modeling from the National Park Service and the United States Department of Agriculture Forest Service provided to EPA during the permit review period. This resulted in a long series of written and verbal communications, meetings, conference calls, and a Class I modeling protocol addendum (provided in this report as Appendix A) to determine a means to address the comments with an updated modeling analysis. Over this period of time, the project layout has been revised and the project location has been adjusted. This report documents the results of the updated PSD Class I modeling analysis. For completeness and convenience to the reader, this document briefly describes the Project and provides an updated PSD Class I area impact analysis to help complete the review of the previously submitted PSD Permit Application. Very few comments were received on the local modeling, but that analysis is being updated as well, based upon the project layout and location adjustments. Another supplemental report will be provided within a few weeks to update the PSD Class II modeling results.

Because this Project will be located on the Navajo Nation, and since the Navajo Nation does not yet have PSD delegation, this application is being submitted to the U. S. Environmental Protection Agency (EPA), in Region 9. Sithe Global and DPA continue to work closely with the Navajo Nation Environmental Protection Agency concerning the Project and this application.

1.2 Document organization

This document provides an updated air quality impact analysis for the proposed project emissions in PSD Class I areas and in distant PSD Class II areas. Section 2 provides an overview of the proposed Project and a description of the proposed project emissions. Section 3 discusses the regulatory setting for the Project. Section 4 presents a detailed discussion of the dispersion modeling procedures and the results of the analysis. Section 5 references the regulatory and technical citations used in the document.

Attached to this document (or provided separately) are:

- the modeling protocol addendum (see Appendix A);
- modeling files on a CD or DVD, and supplementary modeling results; and
- documentation of source information used for the cumulative analysis.

2.0 Proposed Project

Sithe Global, under a development agreement with the Navajo Nation's Diné Power Authority, is proposing to develop a technologically advanced, mine-mouth coal-fired power plant. The power plant will be erected in the Northwestern Area of New Mexico adjacent to Navajo Nation coal reserves at a operating mine of BHP Billiton, one of the largest domestic suppliers of low-sulfur coal. The power plant will be a supercritical pulverized coal type and is designed for a total nominal generation capacity of 1,500 MW (gross), composed of two units of 750 MW (gross) and 683 MW (net) each. Use of a once through, supercritical steam cycle and other design features will enable this plant to be one of the most efficient dry cooled steam electric plants ever built in the United States with a net efficiency greater than 40%, based on the lower heating value of the fuel. State-of-the-art emission controls will be used to minimize emissions of potential air pollutants. Water consumption will be minimized by using a Heller system, dry natural draft cooling tower. Solid wastes produced by combustion of the coal and the air pollution control system will be returned to the mine.

2.1 Project location and general facility design

The Desert Rock Energy Facility will be located on a ~580 acre site close to the Navajo Nation coal reserves leased to BHP Billiton in Northwest New Mexico. The site location is ~25 miles Southwest of Farmington, San Juan County, New Mexico in the Navajo Indian Reservation as shown in Figure 2-1. The site can be accessed via Highway 249 from Shiprock, NM and further on Indian Service Routes to be improved for transportation purposes by grading, drainage, and paving.

Figure 2-2 provides a photo of the project site. The project site can be characterized by open prairie in simple terrain. Figure 2-3 shows the location of the Desert Rock Energy Facility relative to other power plants in the area. The location of the main stack is at 719690E, 4041760N zone 12, NAD 83; this translates into lat/long: 36° 29' 46"N, 108° 32' 50"W.

Figure 2-1 General view – Farmington region

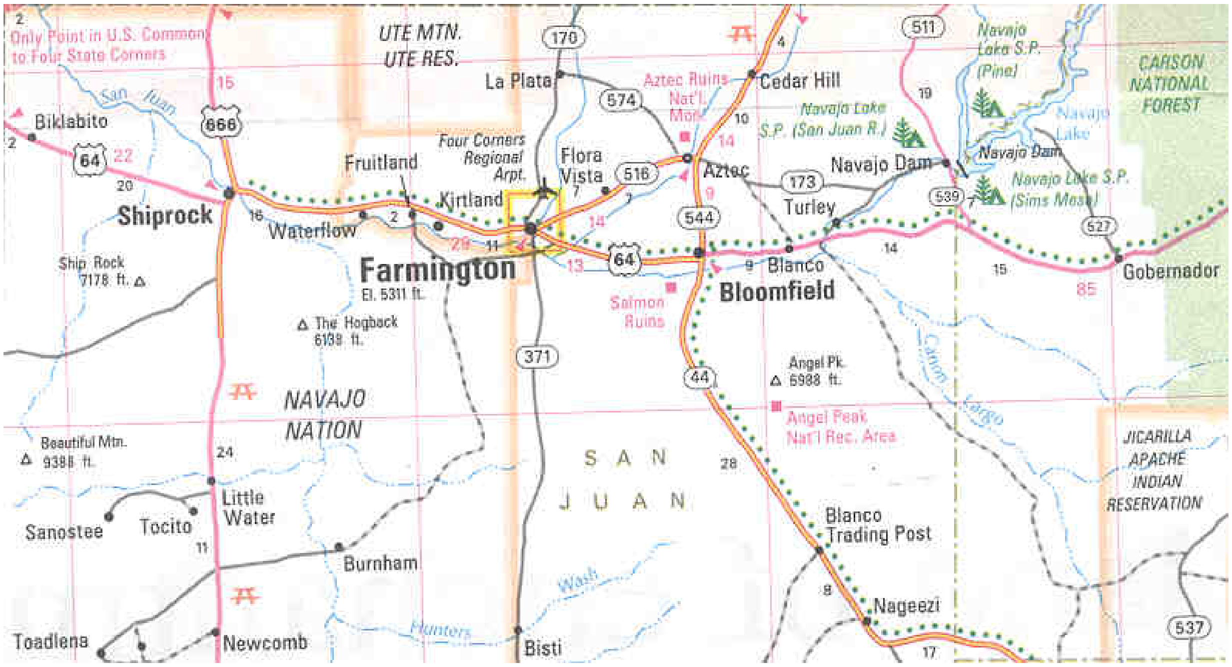
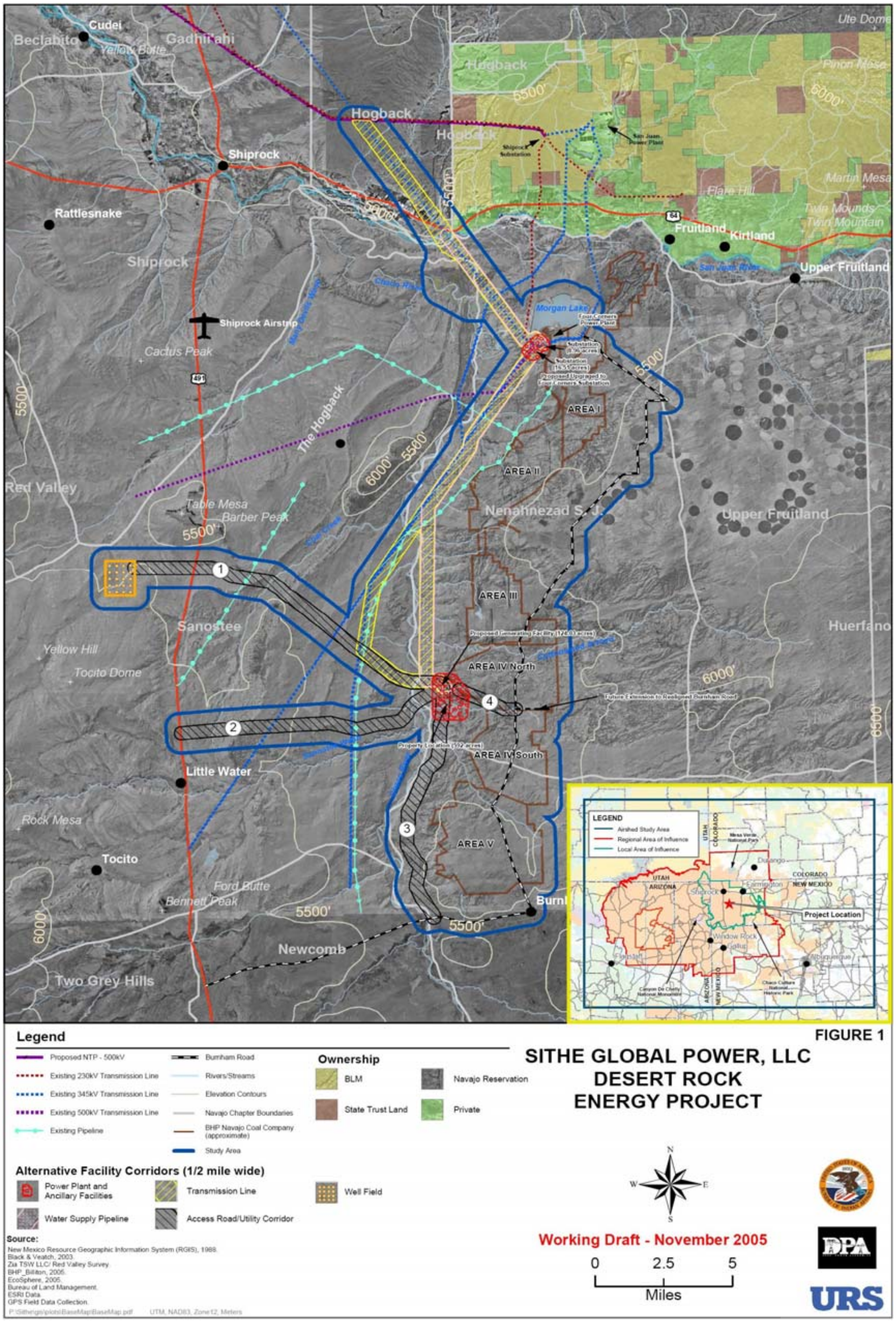


Figure 2-2 Local terrain in the power plant site area

Figure 2-3 Location of Desert Rock Energy Facility in relation to other nearby generating stations



2.2 Proposed project emissions

The power plant will be of the supercritical pulverized coal type and is designed for a total nominal generation capacity of 1,500 MW (gross) divided into two units of 750 MW (gross) and 683 MW (net) each. Each boiler will have a heat input of capacity of approximately 6,800 MMBtu/hr (extreme maximum) and will burn up to 382 tons/hour of coal. In the supercritical cycle, steam is produced at 3,626 psi and 1,112 °F at a rate of 4,636,000 lb/hour. The high-pressure steam is fed through a steam turbine generator to generate electricity and then to a direct contact jet condenser.

2.2.1 Planned emissions controls

Air pollution controls for the pulverized coal-fired boilers will consist of the following:

- Low-NOX burners and selective catalytic reduction (SCR) to control NOx emissions;
- Low sulfur coal, hydrated lime injection before a fabric filter, and wet limestone flue gas desulfurization to control SO2 emissions;
- Hydrated lime injection before a fabric filter, and wet limestone flue gas desulfurization to control acid gas emissions including sulfuric acid mist;
- Activated carbon injection (if needed), hydrated lime injection before a fabric filter, and wet limestone flue gas desulfurization to control mercury emissions;
- A fabric filter to control particulate emissions; and
- Good combustion to control CO and VOC emissions.
- A fabric filter to control particulate emissions; and
- Good combustion to control CO and VOC emissions.

Potential criteria pollutant emissions are summarized in Section 2.2.2. Emission rates are based on preliminary plant design data from Steag, Encotec, other vendor data, and EPA emission factors from AP-42.

Emissions of all criteria pollutants from all sources are controlled by applying BACT. Maximum annual criteria pollutant emission rates are summarized in Table 2-1. The two 750 MW PC boilers are the primary emission sources whose emissions and stack parameters are summarized in Table 2-2.

Table 2-1 Summary of criteria pollutant maximum potential emissions

Pollutant	PC Boilers (tpy)	Auxiliary Boilers (tpy)	Emergency Generators (tpy)	Fire Water Pumps (tpy)	Material Handling (tpy)	Storage Tanks (tpy)	Project PTE (tpy)
CO	5,526	2.55	0.17	0.031	n/a	n/a	5,529
NO_x	3,315	7.13	2.26	0.41	n/a	n/a	3,325
SO_2	3,315	3.61	0.068	0.012	na/	n/a	3,319
PM(1)	553	1.02	0.083	0.015	16.1	n/a	570
PM_{10}(2)	1,105	1.68	0.077	0.014	12.9	n/a	1,120
VOC	166	0.17	0.11	0.019	n/a	0.14	166
Lead	11.1	0.00064	0.000012	0.0000022	n/a	n/a	11.1
Fluorides	13.3	Neg	Neg	Neg	Neg	Neg	13.3
H_2SO_4	221	0.062	0.002	0.0004	n/a	n/a	221
Mercury	0.057	0.00021	Neg	Neg	n/a	n/a	0.057
Hydrogen Sulfide	Neg	Neg	Neg	Neg	n/a	n/a	Neg
Total Reduced Sulfur	Neg	Neg	Neg	Neg	n/a	n/a	Neg
Reduced Sulfur Compounds	Neg	Neg	Neg	Neg	n/a	n/a	Neg

n/a – not applicable, neg – negligible

1 PM is defined as filterable particulate matter as measured by EPA Method 5.

2 PM_{10} is defined as solid particulate matter smaller than 10 micrometers in diameter as measured by EPA Method 201 or 201A plus condensable particulate matter as measured by EPA Method 202. Because PM_{10} includes condensable particulate matter and PM does not include condensable particulate matter, PM_{10} emissions are higher than PM emissions.

2.2.2 Stack characteristics and emission rates

The PSD Class I modeling analyses used emission rates presented in Tables 2-2 for the Desert Rock Energy Facility, which characterize emissions from the main stack alone. Other ancillary combustion sources associated with the plant were not included in the Class I impact analysis because their emissions of SO_2, NO_x, and PM_{10} are generally on the order of a tenth of a percent of the main stack emissions, and their impacts are expected to be localized to a few km from the plant.

The primary PM_{10} emissions were speciated according to procedures in recently submitted PSD permit applications for purposes of visibility impact predictions. The National Park Service (NPS) has requested that the PM_{10} be broken down into separate components based on the particles' light scattering properties. Those components are: (1) soils, (2) elemental carbon, and (3) organic aerosols. These components are modeled separately because their light scattering/absorption effectiveness differs. For example, elemental carbon can produce 10 times more visibility degradation than does the “soils” (e.g., ash or “soils”) portion of PM_{10} emissions.

The “modeled” soils component of the primary PM_{10} emissions consists of soils plus inorganic aerosols because they are assumed to have similar light scattering properties. Soils are assumed to be 96.3 percent of the filterable PM_{10} (EPA, 2002). The organic aerosols “modeled” component of the primary PM_{10} emissions is assumed to be the condensable portion of PM_{10}. The elemental carbon “modeled” component of the primary PM_{10} emissions is assumed to be 3.7 percent of the filterable PM_{10} (EPA, 2002).

CALPUFF regional haze modeling typically considers primary SO_4 emissions (derived from H_2SO_4). Primary emissions of SO_4 are modeled because calculations of regional haze are sensitive to SO_4, which combine with free atmospheric ammonia to form light-scattering ammonia sulfate fine particles. For this Project, SO_4 was included in the regional haze analysis as a primary pollutant.

In addition to breaking the PM_{10} down into different components based on light scattering properties, the primary PM_{10} emissions were also broken down into different components based on a size distribution. The size distribution is used to more accurately reflect the rate at which the PM_{10} gravitationally settles out of the atmosphere and how differently sized particles affect light scattering/absorption. The size distributions are based on the AP-42, Tables 1.1-5 and 1.1-6. This size distribution is shown in Table 2-3. The filterable PM_{10} emissions are distributed by the applicable size distributions in AP-42, Table 1.1-6. Table 1.1-5 of AP-42 indicates that condensable PM and elemental carbon can be assumed to be < 1.0 micron in diameter. Therefore, the condensable and elemental carbon emissions are assigned to the smallest size category.

CALPUFF was run using the SO_2 and NO_X emissions in Table 2-2. PM_{10} was modeled with a unit emission rate for each size distribution category found in Table 2-3. The PSD PM_{10} increment results were then assessed by scaling each “size” components unit emission results by the emissions listed in Table 2-4 using the POSTUTIL postprocessor. Like-wise, for the regional haze analysis, the POSTUTIL postprocessor was used to scale each “size” components unit emission results based on the emissions listed in Table 2-4 and create the different light scattering components of PM_{10}.

Table 2-2 Short-Term and annual emissions data and stack parameters

Plant Performance				
Full load heat input to both boilers (MMBtu/hr)	13,600			
Emissions for both Boilers	**100% Load Emissions (both Boilers)**			
	lbs/MMBtu		**g/s**	
SO_2 (24-hour average)[1]	0.060		102.81	
NO_x (24-hour average)	0.060		102.81	
PM_{10} (24-hour average)[2]	0.020		34.27	
H_2SO_4 (24-hour average)[3]	0.004		6.85	
Stack Parameters	**English Units**		**Metric Units**	
Stack gas exit temperature	122.0	Fahrenheit	323.15	Kelvin
Stack gas exit velocity	82.0	ft/sec	24.99	m/sec
Stack height	917.0	feet	279.49	meters
Stack diameter[4]	36.8	feet	11.21	meters
1S12S1 (Main Stack ID)[5]	719,689.5 East 4,041,760.4 North	UTM Zone 12 NAD-1983 (meters)	127.250 East 54.998 North	LCC[6] (km)
Base Elevation	5400	feet	1645.8	meters

1 3-hour average SO_2 emission rate is 0.09 lbs/MMBtu. The modeling results have been scaled accordingly.
2 Speciation and size distribution data on how PM_{10} was modeled is contained in Tables 2-3 through 2-5.
3 H_2SO_4 is modeled as SO_4 in CALPUFF. SO_4 emissions are calculated based on the ratio of molecular weights of SO_4/H_2SO_4 (or 96/98).
4 Effective diameter of two flues = 26 ft. * sqrt(2) = 36.8 ft.
5 Both boilers exhaust through a common dual flue stack and were modeled as a single source.
6 The LCC (Lambert Conformal Coordinate) System is based on:
a reference of 36.0N and 110.0W, 0.0 and 0.0 false easting and northing,
30N and 60N two standard parallels, and a WGS-1984 spheroid.

Table 2-3 Size distribution of particulate matter used in CALPUFF modeling

Aerodynamic Diameter (μm)	Filterable PM[1] (%)	Filterable PM_{10} Only (%)	Condensable PM_{10} Only (%)
>15	3.0		
10 - 15	5.0		
6 - 10	15.0	16.3	
2.5 - 6	24.0	26.1	
1.25 - 2.5	22.0	23.9	
1.0 - 1.25	6.0	6.5	
0.625 - 1.0	11.0	12.0	
0.5 - 0.625	14.0	15.2	100.0
Total	100.0	100.0	100.0
1 Data obtained from EPA's AP-42, Table 1.1-6 (Baghouse)			

Table 2-4 Particle size distribution emission rate summary used for the CALPUFF run to determine the maximum PM_{10} concentrations

Geometric Mass Mean Diameter (μm)	PM_{10} Emissions (g/s) (per Boiler)
	100 % Load
6-10	2.7938
2.5 - 6	4.4702
1.25 – 2.5	4.0976
1.0 – 1.25	1.1175
0.625 – 1.0	2.0488
0.5 – 0.625	19.7432

Table 2-5 Particle size distribution emission rates used for the regional haze analysis

Geometric Mass Mean Diameter (μm)	Soils (Inorganic) Emissions (g/s)	Organic Emissions (g/s)	Elemental Carbon Emissions (g/s)
6 - 10	2.79	0.00	0.00
2.5 - 6	4.47	0.00	0.00
1.25 - 2.5	3.95	0.00	0.15
1.0 - 1.25	1.08	0.00	0.04
0.625 - 1.0	1.97	0.00	0.08
0.5 - 0.625	2.51	10.28	0.10

3.0 PSD Class I regulatory setting

This Project will be built on Navajo Nation trust land leased from the Navajo Nation through the U.S. Department of Interior. As a federally recognized tribe, the Navajo Reservation is considered sovereign land and is not subject to the regulations of the State of New Mexico. They are subject to the U.S. Environmental Protection Agency (EPA) regulations as are individual States. Air Permitting for this Project will be under the jurisdiction of EPA Region 9, since the majority of the Navajo Nation is located in Arizona. All local regulations will be administered by the Navajo Nation EPA (NN EPA) which have been adopted for the most part from the New Mexico Environmental Department (NMED) regulations. The Navajo Nation has not been delegated authority under the Clean Air Act to issue a Prevention of Significant Deterioration permit by EPA, so the PSD permit will be issued by EPA Region 9. DPA and Steag are continuing to coordinate with NN EPA on the Project.

This section presents a review of the air quality regulatory requirements applicable to the construction and operation of the Desert Rock Energy Facility in regards to assessing impacts at PSD Class I areas.

PSD review applies to specific pollutants for which a project is considered major and the project area is designated as attainment or unclassified with respect to the NAAQS. For a new facility to be subject to PSD review, the project's potential to emit (PTE) must exceed the PSD major source thresholds, which are:

- 100 tpy if the source is one of the 28 named source categories, or
- 250 tpy for all other sources.

The Desert Rock Energy Facility is one of the 28 named categories, specifically a fossil fuel fired steam-generating plant with heat input greater than 250 MMBtu/hour. As such, the applicable PSD threshold is 100 tpy. Once it is determined that a pollutant exceeds the PSD major source threshold, additional pollutants will be subject to PSD review if their potential to emit (PTE) exceeds the PSD Significant Emission Rates. Table 3-1 compares the Desert Rock Energy Facility annual PTE with the PSD significant emission rates. As shown in the table, the Desert Rock Energy Facility's PTE is estimated to be greater than the PSD significant emission rates for these PSD pollutants. PSD review and approval will therefore be required for these pollutants.

In addition to the analysis of PSD Class I Increment compliance, the PSD Class I analysis must also address impacts to special attributes of a Class I area that deterioration of air quality may adversely affect. Such attributes are referred to as Air Quality Related Values and are specified by the Federal Land Manager (FLM) of the respective Class I area. These analyses generally include visibility impacts, such as contribution to regional haze, and impacts from acid deposition.

Table 3-1 Comparison of Desert Rock Energy Facility annual PTE to the PSD thresholds

Pollutant	PSD Significant Emission Rate (tpy)	Project PTE[1] (tpy)
CO	100	5,529
NO_x	40	3,325
SO_2	40	3,319
Particulate Matter (TSP/PM)[2]	25	570
PM_{10}[3]	15	1,120
Ozone (VOC)	40	166
Lead	0.6	11.1
Fluorides	3	13.3
Sulfuric Acid Mist (H_2SO_4)	7	221

1 Assumes 95% annual capacity factor at full load emissions.

2 PM is defined as filterable particulate matter as measured by EPA Method 5.

3 PM_{10} is defined as solid particulate matter smaller than 10 micrometers in diameter as measured by EPA Method 201 or 201A plus condensable particulate matter as measured by EPA Method 202. Because PM_{10} includes condensable particulates and PM does not include condensable particulate matter, PM_{10} emissions are higher than PM emissions.

4.0 Air quality impact analysis: Class I impacts

4.1 Overview

This Section addresses all PSD requirements related to air quality and air quality related values impact analyses as the nearby PSD Class I areas. As mentioned previously, the location of the Desert Rock Energy Facility is approximately 25 - 30 miles (40 – 60 km) southwest of Farmington, New Mexico in the Four Corners area where Arizona, Colorado, New Mexico, and Utah meet. It is a region that contains a significant number of National Parks and Wilderness Areas, some of which have been designated as PSD Class I areas. Sithe Global and ENSR have worked closely with EPA and the Federal Land Managers (FLMs) from the National Park Service (NPS) and the USDA Forest Service, as well as other Navajo Nation, State, and Federal agencies, to perform the analyses for determining the potential for air quality impacts from this Project.

In May, 2004, Steag, LLC (now Sithe Global) submitted a Prevention of Significant Deterioration (PSD) permit application to EPA Region 9 along with the associated modeling protocol and modeling analysis for assessing the air quality impacts of the proposed Desert Rock Generating Station. This Project is a mine-mouth coal-fired power plant, to be located in northwestern New Mexico about 50 km southwest of Farmington, New Mexico, within the trust lands of the Navajo Nation. The plant will receive its coal supplies from BHP Billiton New Mexico Coal.

The modeling analysis submitted in May 2004 used the CALPUFF (Scire et al., 2000) model for both short-range and long-range transport modeling. While CALPUFF is the preferred EPA model for long-range transport (distances of at least 50 km), it is also used on a case-by-case basis for local complex winds. The results of a 1982 study focusing upon meteorological conditions in northwestern New Mexico provided evidence that the local flows exhibit complex behavior. Therefore, EPA Region 9 approved the use of the CALPUFF model with a 3-year meteorological database (2001-2003) for evaluating impacts on a consistent basis at all distances. This general modeling approach will not change for future modeling of the facility, except that a finer grid mesh will be employed for the local modeling near the proposed project site (including the local Class II modeling as well as Class I impacts at Mesa Verde; see Section 3-1). In addition, the National Park Service has elected to add three specific periods (more details in Section 3.3) to the analysis for regional haze at PSD Class I areas.

The two proposed units will exhaust to a common stack which will be built to the Good Engineering Practice (GEP) height of 279.5 meters (917 feet). For long-range transport modeling at distant (beyond 50 km) PSD Class I and sensitive Class II areas, the emissions from this main stack only were modeled in the 2004 submittal. Future modeling will use these same procedures for distant Class I and sensitive Class II areas. For short-range modeling (at distances within 50 km of the project site), emissions from fugitive sources and other intermittent and low-level combustion sources were also considered in the 2004 submittal. A separate modeling analysis submittal will be provided that will include an assessment of impacts on local Class II and distant sensitive Class II areas.

Section 4.2 reviews the Class I modeling approach. The Class I PSD Increment and Air Quality Related Values (AQRV) modeling results for the project emissions are provided in Section 4.3. Section 4.4 provides a supplemental regional haze analysis requested by the National Park Service using NPS 4-km and 12-km MM5 datasets. For SO_2 Class I PSD Increment, impacts were modeled with the proposed project emissions were found to exceed the significant impact criteria. Therefore, a cumulative impacts analysis for SO_2 increment consumption in those specific PSD Class I areas was performed and results are provided in Section 4.5. The results of all the modeling evaluations are summarized in Section 4.6.

4.2 PSD Class I modeling approach

The impacts at PSD Class I areas within 300 kilometers of the proposed plant (see Figure 4-1) were modeled with CALPUFF. The PSD Class I areas included the following National Parks (NP) or National Monuments (NM):

- Arches
- Bandelier
- Black Canyon of the Gunnison
- Capitol Reef
- Canyonlands
- Grand Canyon
- Great Sand Dunes
- Mesa Verde
- Petrified Forest

PSD Class I areas also included the following Wilderness Areas (WA), all administered by the USDA Forest Service:

- La Garita
- Pecos
- San Pedro Parks
- West Elk
- Weminuche
- Wheeler Peak

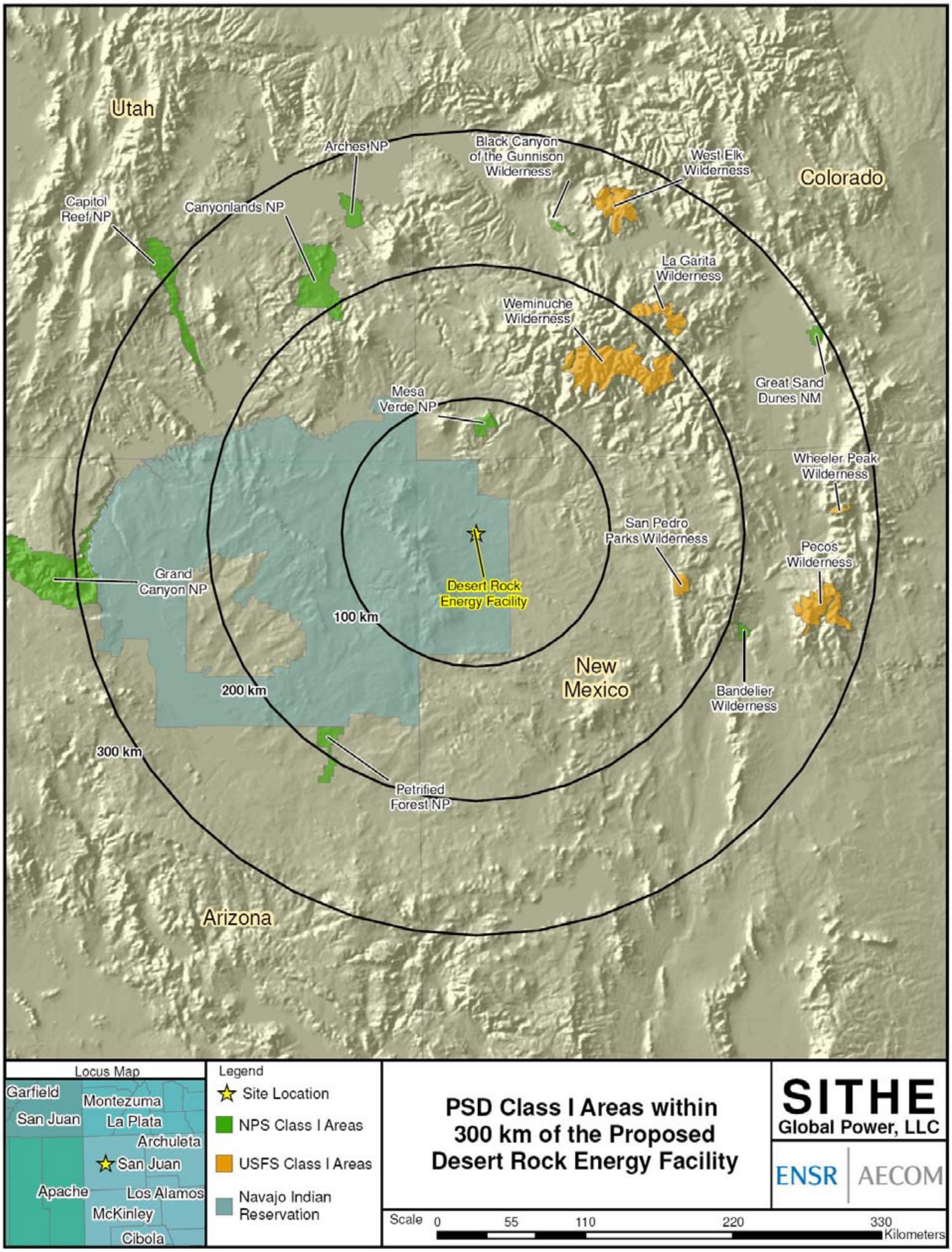
The long-range CALPUFF modeling analysis addressed ambient air impacts on Class I PSD Increments and AQRVs at these Class I areas.

As discussed in the previously submitted modeling protocol (ENSR, 2004), ENSR used the CALPUFF modeling system for both the Class I PSD modeling and Class II analyses due to the presence of complex winds in the vicinity of the proposed Desert Rock Energy Facility. The technical options used for the CALPUFF modeling where agreed upon by upon by EPA Region 9, the NPS, and ENSR and are outlined in the attached modeling protocol addendum.

ENSR used the following recently-released versions of the CALPUFF modeling system:

- CALMET version 5.547 (level 041016),
- CALPUFF version 5.724 (level 041013), and
- CALPOST version 5.634 (level 050114).

Figure 4-1 PSD Class I areas considered in the CALPUFF modeling analysis



4.2.1 Good engineering practice stack height analysis

Federal stack height regulations limit the stack height used in performing dispersion modeling to predict the air quality impact of a source. GEP height is reflective of the height necessary to avoid having the exhaust caught in the downward flow of air currents created by structural and or ground effects, referred to as downwash. Sources must be modeled at the actual physical stack height unless that height exceeds the Good Engineering Practice (GEP) stack height. In such a case, the portion of a stack that exceeds GEP height as defined by EPA cannot be used in atmospheric modeling of the source's impacts. Conversely, if the physical stack height is less than the formula GEP height, the potential for the source's plume to be affected by aerodynamic wakes created by the building(s) must be evaluated in the dispersion modeling analysis.

A GEP stack height analysis was performed for the main stack at the proposed facility in accordance with the EPA's "Guideline for Determination of Good Engineering Practice Stack Height" (EPA, 1985). A GEP stack height is defined as the greater of 65 meters (213 feet), measured from the ground elevation of the stack, or the formula height (H_g), as determined from the following equation:

$$H_g = H + 1.5\ L$$

where

H is the height of the nearby structure which maximizes H_g, and

L is the lesser dimension (height or projected width) of the building.

Both the height and the width of the building are determined through a vertical cross-section perpendicular to the wind direction. In all instances, the GEP formula height is based upon the highest value of H_g as determined from H and L over all nearby buildings over the entire range of possible wind directions. For the purposes of determining the GEP formula height, only buildings within 5L of the source of interest are considered.

The GEP analysis was conducted with EPA's BPIP program, version 95086 to demonstrate that the proposed main stack is fully creditable up to 917 feet. Figure 2-5 show the buildings considered in the GEP analysis in relationship to the main stack. The steam generator buildings located west of the main stack were the determinants in this analysis. Each of these two buildings is 367 feet tall and 213 long. The BPIP program combines these two buildings as a squat structure and uses the formula $H_g = 2.5 \times H$. In this case the GEP stack height is 917 feet. The main stack height of 917 feet is at the GEP height; therefore no building dimensions were included in CALPUFF for the main stack.

4.2.2 Modeling domain and meteorological data

The CALPUFF modeling was conducted using several levels of resolution in both in the CALMET runs and MM5 input. This was done in an effort to satisfy the NPS concerns about the representativeness of the meteorological data used as input to CALMET and then subsequently CALPUFF. The initial modeling was conducted with three years, 2001-2003, of MM5 and RUC datasets. The resolutions of those datasets are as follows: 2001 MM5 at 36 km, 2002 MM5 at 12 km, 2003 RUC at 20 km. The spatial coverage of these datasets was sufficient for the large modeling domain as shown in the May 2004 submittal. This domain was designed to cover all 15 Class I areas (or portions thereof within 300 km of the proposed source) plus a 50-km buffer. It extends approximately 50 kilometers east of Great Sand Dunes National Park, north of West Elk Wilderness, south of Petrified Forest, as well as 350 kilometers west of the project site. This modeling domain is shown in Figure 4-2. The additional buffer distances beyond the Class I areas allow for the consideration of puff trajectory recirculations. The modeling domain covers a 680 km x 552 km (E-W / N-S) area with a 4-km grid resolution. The southwest corner of the grid is located at approximately 34.28° N latitude and 112.46° W longitude.

All the PSD Class I areas were modeled on the 4-km modeling domain except for Mesa Verde. Mesa Verde falls within the domain needed for the local Class II modeling, which is being modeled with a grid resolution of 500 meters. It is also in an area with significant terrain features that are better resolved with a grid spacing less than 4 km. Therefore, ENSR conducted all modeling for Mesa Verde with a 500-m CALMET grid resolution, while the other Class I areas were modeled with the 4-km grid. The domain area of the 500-m resolution run was limited to an area that encapsulates at least a 50-km buffer around Mesa Verde and the proposed source. This separate modeling domain was designed to cover a 125 km x 190 km (E-W / N-S) area with a 500-m grid resolution. The southwest corner of the grid is located at approximately 36.04° N latitude and 109.15° W longitude. Figure 4-2 shows the location of this domain with respect to the much larger 4-km modeling domain.

The 4-km and 500-m CALPUFF domains were used to assess PSD increment, regional haze, and acidic deposition at all the PSD Class I areas within 300 km of the proposed Project in order to assess the air quality impacts of the proposed Project.

A third modeling domain was used to accommodate the NPS 4-km MM5 data that was provided for special periods of interest by the NPS. The use of this data and the analysis conducted for these special periods of interest is discussed in more detail in Section 4.4. The spatial extent of the NPS 4-km MM5 data was not sufficient to cover the entire modeling domain and all PSD Class I areas within 300 km of the proposed project site. Therefore, an inner modeling domain was designed to cover the extent of the NPS 4-km MM5 data as shown in Figure 4-2. This inner domain covers a 492 km x 372 km (E-W / N-S) area with a 3-km grid resolution. Only those PSD Class I areas within the extent of this modeling domain were assessed using the 4-km NPS MM5 data. For those PSD Class I areas outside the domain designed for the 4-km NPS MM5 data, an outer 680 km x 552 km (E-W / N-S) modeling domain with a 4-km grid resolution was used with 12-km MM5 data provided by the NPS for the same special periods.

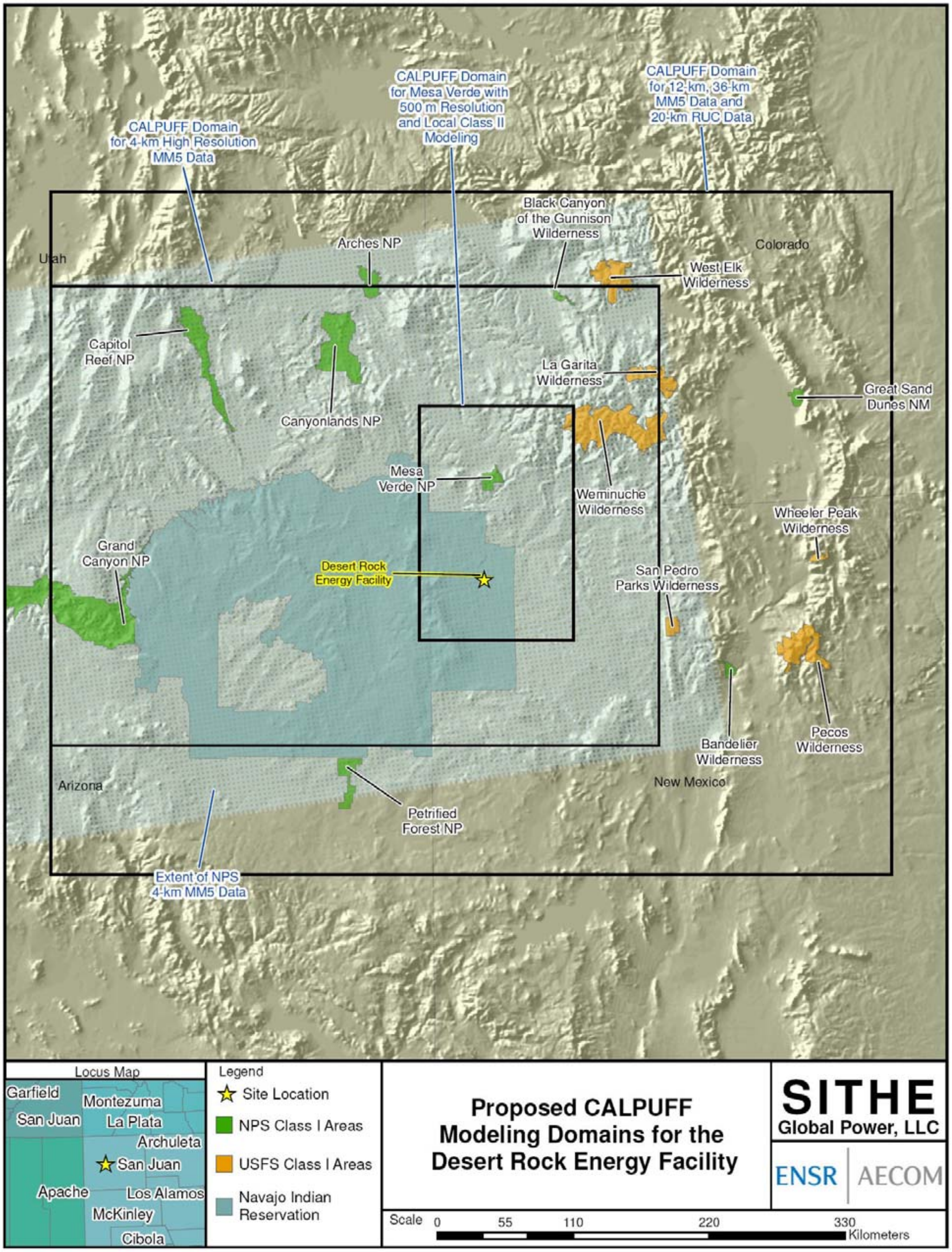
All CALMET simulations were conducted with the input of available hourly NWS surface and precipitation observations that had sufficient data capture to add weight to the analysis and help derive the Stage 2 wind field. When available, surface meteorological data from CASTNET sites was also used. Twice-daily upper air soundings were also incorporated into the Stage 2 wind field. The attached modeling protocol addendum lists additional technical modeling options used to conduct the CALMET simulations.

Due to the size of these modeling domains, all the modeling was conducted with a Lambert Conformal coordinate (LCC) system. The LCC projection was used because it accounts for the curvature of the Earth's surface. The LCC projection for this analysis is based on the WGS-84 datum and standard parallels of 30° N and 60° N, with an origin of 36.0° N and 110.0° W.

4.2.3 Receptors

The receptors used in the refined CALPUFF analysis were limited to those actually within the PSD Class I boundary. However, if the park boundary extended more than 300 kilometers from the project site, then only those receptors within 300 kilometers of the main stack were modeled in this CALPUFF analysis. The receptors for Arches, Bandelier, Black Canyon of the Gunnison, Capitol Reef, Canyonlands, Grand Canyon, Great Sand Dunes, Mesa Verde, and Petrified Forest National Parks, along with La Garita, Pecos, San Pedro Parks, West Elk, Weminuche, and Wheeler Peak Wilderness Areas were obtained from a database of receptors for all Class I areas produced by the National Park Service (found at http://www2.nature.nps.gov/air/Maps/Receptors).

Figure 4-2 PSD Class I CALPUFF modeling domain



4.3 PSD Class I increments and AQRVs analysis for standard MM5 data sets

In order to determine if impacts at the PSD Class I areas assessed for this analysis could be considered significant, modeling results are compared to Significant Impact Levels (SILs), which act as screening levels to determine if further analysis is required. Table 4-1 provides the PSD Class I SILs that were used for this application. If impacts are determined to be greater than the SILs, then a cumulative analysis is performed which includes background emission sources that would consume and/or expand PSD increment. The PSD Class I Increments, which are levels that cannot be exceeded, are also shown in Table 4-1.

The regional haze modeling was conducted using the FLAG approach (with an RHMAX = 95% and EPA f(RH) curves), and alternative analyses considering the following options:

- Using the BART approach with Method 6 and reporting the 98 percentile day (8^{th} highest for each year, and 22^{nd} highest over 3 years) to determine whether the Project has an impact over 0.5 deciviews (about 5% change in extinction). This approach tends to account for meteorological interference events that the FLAG approach does not handle.
- A sensitivity analysis on the assumed level of wintertime background ammonia concentrations, since the previous (and new) modeling indicates that peak regional haze impacts occurred in winter. These impacts are showing higher nitrate vs. sulfate contributions, which is inconsistent with IMPROVE data showing much higher sulfate than nitrate species in the fine particulate measurements in winter months. Results are presented with this alternative for both the Method 2 and Method 6 (BART-like) approach.
- Use of an alternative dispersion option (similar to the AERMOD treatment – MDISP = 2 and MPDF = 1) was considered for the project emission impact because this method is consistent with EPA's recent updates for short-range model, for which ISCST3 has been replaced by AERMOD. The protocol addendum also mentions that existing evaluation results with this option show overall better CALPUFF performance than with the ISC-like option. This conclusion is also in agreement with recent statements (2005) by Joe Scire of Earth Tech, the model developer. Results are presented with this alternative for both the Method 2 and Method 6 (BART-like) approach.

As noted in FLAG (2000), if a project-related change in extinction is less than 5 percent of the background extinction, then the project's regional haze impact is determined to be insignificant and no further modeling is required to demonstrate no adverse impact. If the project-related change in extinction exceeds 5 percent, then further (or supplemental) analysis is warranted.

Supplemental regional haze analyses using 4-km and 12-km MM5 data produced by the NPS are provided in Section 4.4.

The sulfur and nitrogen deposition results were compared to the Deposition Analysis Threshold (DAT) of 0.005 kg/ha/yr recently developed by the USDA Forest Service for a new PSD emission sources. There are no published thresholds for acidic deposition for the PSD Class I areas in which acidic deposition impacts will be addressed. The deposition results are provided here for evaluation by the FLMs.

The FLMs need to have a reasonable assurance that cumulative deposition from all new sources does not exceed 50% of natural background. Natural background in eastern Class I areas is 0.5 kg/ha/yr, and is about half that in western Class I areas. This value was divided by 2 to attain 50% of natural background and further divided by 25, which is a safety factor to account for cumulative new source growth (0.25 x 0.5 x 0.04 = 0.005). Besides the assumption of 25 new projects that would impact a specific Class I area, the use of a 0.005 kg/ha/yr threshold of concern for a new PSD source should be viewed in the context of changes to other emissions in the area. This issue is discussed further in Section 4.6.1.

Table 4-1 Significant impact levels and PSD increments

Pollutant	Averaging Period	Significant Impact Levels	PSD Increments
		Class I[(1)] ($\mu g/m^3$)	Class I ($\mu g/m^3$)
NO_X	Annual	0.1	2.5
SO_2	Annual	0.1	2
	24-hour	0.2	5
	3-hour	1	25
PM_{10}	Annual	0.16	4
	24-hour	0.32	8
1 Proposed by EPA (1996; 61 FR 38249)			

4.3.1 PSD Class I increment results

Results of the PSD Class I increment modeling from the proposed project emissions are provided in Table 4-2 through 4-4 respectively for SO_2, PM_{10}, and NO_X. Values bolded are greater than the Class I significance levels. The NO_X and PM_{10} impacts are insignificant in all PSD Class I areas, and only the SO_2 impacts are significant, for short-term averages. Note that the highest SO_2 impacts are only about 20% of the full PSD Class I increment. A cumulative modeling analysis was performed for SO_2 at those PSD Class I areas with modeled predictions above the SIL in Table 4-1. The modeling approach used to conduct this cumulative analysis is documented in Section 4.5.

Table 4-2 PSD Class I increment modeling results for SO_2 (2001-2003)

Class I Area	Averaging Period	Modeled Concentrations ($\mu g/m^3$)			3-Year Max. Conc.	Class I SIL	Exceed. of SIL	PSD Class I Increment	% of PSD Class I Increment
		2001	2002	2003	($\mu g/m^3$)	($\mu g/m^3$)	Yes/No	($\mu g/m^3$)	%
Arches	3-hr	0.682	0.664	0.720	0.720	1.0	No	25	--
	24-hr	0.172	0.113	0.122	0.172	0.2	No	5	--
	Annual	0.008	0.004	0.005	0.008	0.1	No	2	--
Bandelier	3-hr	1.268	0.961	0.991	**1.268**	1.0	Yes	25	5%
	24-hr	0.223	0.146	0.273	**0.273**	0.2	Yes	5	5%
	Annual	0.015	0.013	0.017	0.017	0.1	No	2	--
Black Cany. Gun.	3-hr	0.929	0.427	0.785	0.929	1.0	No	25	--
	24-hr	0.180	0.095	0.144	0.180	0.2	No	5	--
	Annual	0.008	0.005	0.004	0.008	0.1	No	2	--
Canyonlands	3-hr	1.479	1.161	1.077	**1.479**	1.0	Yes	25	6%
	24-hr	0.476	0.202	0.157	**0.476**	0.2	Yes	5	10%
	Annual	0.013	0.008	0.008	0.013	0.1	No	2	--
Capitol Reef	3-hr	0.674	0.611	0.711	0.711	1.0	No	25	--
	24-hr	0.159	0.127	0.140	0.159	0.2	No	5	--
	Annual	0.004	0.002	0.005	0.005	0.1	No	2	--
Grand Canyon	3-hr	0.365	0.261	0.447	0.447	1.0	No	25	--
	24-hr	0.086	0.127	0.105	0.127	0.2	No	5	--
	Annual	0.001	0.001	0.002	0.002	0.1	No	2	--
Great Sand Dunes	3-hr	0.467	0.547	0.412	0.547	1.0	No	25	--
	24-hr	0.111	0.147	0.097	0.147	0.2	No	5	--
	Annual	0.004	0.006	0.005	0.006	0.1	No	2	--
La Garita	3-hr	0.761	0.727	0.483	0.761	1.0	No	25	--
	24-hr	0.151	0.098	0.089	0.151	0.2	No	5	--
	Annual	0.006	0.007	0.004	0.007	0.1	No	2	--
Mesa Verde	3-hr	4.706	3.729	4.199	**4.706**	1.0	Yes	25	19%
	24-hr	0.790	0.475	0.703	**0.790**	0.2	Yes	5	16%
	Annual	0.044	0.035	0.020	0.044	0.1	No	2	--
Pecos	3-hr	0.690	0.599	0.647	0.690	1.0	No	25	--
	24-hr	0.117	0.108	0.190	0.190	0.2	No	5	--
	Annual	0.009	0.009	0.011	0.011	0.1	No	2	--
Petrified Forest	3-hr	0.850	0.939	0.635	0.939	1.0	No	25	--
	24-hr	0.165	0.212	0.107	**0.212**	0.2	Yes	5	4%
	Annual	0.003	0.003	0.004	0.004	0.1	No	2	--
San Pedro Parks	3-hr	1.723	1.757	2.379	**2.379**	1.0	Yes	25	10%
	24-hr	0.368	0.233	0.533	**0.533**	0.2	Yes	5	11%
	Annual	0.023	0.022	0.030	0.030	0.1	No	2	--
West Elk	3-hr	0.678	0.557	0.722	0.722	1.0	No	25	--
	24-hr	0.173	0.067	0.142	0.173	0.2	No	5	--
	Annual	0.006	0.004	0.004	0.006	0.1	No	2	--
Weminuche	3-hr	1.803	1.585	1.594	**1.803**	1.0	Yes	25	7%
	24-hr	0.247	0.270	0.221	**0.270**	0.2	Yes	5	5%
	Annual	0.013	0.017	0.011	0.017	0.1	No	2	--
Wheeler Peak	3-hr	0.484	0.414	0.727	0.727	1.0	No	25	--
	24-hr	0.092	0.061	0.090	0.092	0.2	No	5	--
	Annual	0.007	0.006	0.008	0.008	0.1	No	2	--

Table 4-3 PSD Class I increment modeling results for PM_{10} (2001-2003)

Class I Area	Averaging Period	Modeled Concentrations ($\mu g/m^3$)			3-Year Max. Conc.	Class I SIL	Exceed. of SIL	PSD Class I Increment	% of PSD Class I Increment
		2001	2002	2003	($\mu g/m^3$)	($\mu g/m^3$)	Yes/No	($\mu g/m^3$)	%
Arches	24-hr	0.062	0.048	0.047	0.062	0.32	No	8	--
	Annual	0.004	0.002	0.002	0.004	0.16	No	4	--
Bandelier	24-hr	0.079	0.056	0.092	0.092	0.32	No	8	--
	Annual	0.006	0.006	0.006	0.006	0.16	No	4	--
Black Cany. Gun.	24-hr	0.043	0.041	0.050	0.050	0.32	No	8	--
	Annual	0.003	0.002	0.002	0.003	0.16	No	4	--
Canyonlands	24-hr	0.184	0.082	0.067	0.184	0.32	No	8	--
	Annual	0.005	0.003	0.003	0.005	0.16	No	4	--
Capitol Reef	24-hr	0.072	0.038	0.067	0.072	0.32	No	8	--
	Annual	0.002	0.001	0.002	0.002	0.16	No	4	--
Grand Canyon	24-hr	0.034	0.050	0.053	0.053	0.32	No	8	--
	Annual	0.001	0.001	0.001	0.001	0.16	No	4	--
Great Sand Dunes	24-hr	0.039	0.050	0.036	0.050	0.32	No	8	--
	Annual	0.002	0.002	0.002	0.002	0.16	No	4	--
La Garita	24-hr	0.053	0.033	0.031	0.053	0.32	No	8	--
	Annual	0.003	0.003	0.002	0.003	0.16	No	4	--
Mesa Verde	24-hr	0.263	0.168	0.249	0.263	0.32	No	8	--
	Annual	0.016	0.012	0.007	0.016	0.16	No	4	--
Pecos	24-hr	0.043	0.040	0.068	0.068	0.32	No	8	--
	Annual	0.004	0.004	0.004	0.004	0.16	No	4	--
Petrified Forest	24-hr	0.071	0.091	0.055	0.091	0.32	No	8	--
	Annual	0.001	0.001	0.002	0.002	0.16	No	4	--
San Pedro Parks	24-hr	0.127	0.085	0.187	0.187	0.32	No	8	--
	Annual	0.009	0.009	0.011	0.011	0.16	No	4	--
West Elk	24-hr	0.033	0.029	0.049	0.049	0.32	No	8	--
	Annual	0.002	0.002	0.001	0.002	0.16	No	4	--
Weminuche	24-hr	0.085	0.093	0.073	0.093	0.32	No	8	--
	Annual	0.005	0.007	0.004	0.007	0.16	No	4	--
Wheeler Peak	24-hr	0.046	0.024	0.028	0.046	0.32	No	8	--
	Annual	0.003	0.003	0.003	0.003	0.16	No	4	--

Table 4-4 PSD Class I increment modeling results for NO_X (2001-2003)

Class I Area	Averaging Period	Modeled Concentrations (μg/m^3)			3-Year Max. Conc.	Class I SIL	Exceed. of SIL	PSD Class I Increment	% of PSD Class I Increment
		2001	2002	2003	(μg/m^3)	(μg/m^3)	Yes/No	(μg/m^3)	%
Arches	Annual	0.0021	0.0005	0.0012	0.0021	0.1	No	2.5	--
Bandelier	Annual	0.0068	0.0048	0.0074	0.0074	0.1	No	2.5	--
Black Cany. Gun.	Annual	0.0026	0.0011	0.0012	0.0026	0.1	No	2.5	--
Canyonlands	Annual	0.0045	0.0020	0.0027	0.0045	0.1	No	2.5	--
Capitol Reef	Annual	0.0010	0.0003	0.0009	0.0010	0.1	No	2.5	--
Grand Canyon	Annual	0.0002	0.0001	0.0003	0.0003	0.1	No	2.5	--
Great Sand Dunes	Annual	0.0012	0.0017	0.0018	0.0018	0.1	No	2.5	--
La Garita	Annual	0.0027	0.0028	0.0016	0.0028	0.1	No	2.5	--
Mesa Verde	Annual	0.0261	0.0217	0.0115	0.0261	0.1	No	2.5	--
Pecos	Annual	0.0032	0.0025	0.0041	0.0041	0.1	No	2.5	--
Petrified Forest	Annual	0.0007	0.0004	0.0008	0.0008	0.1	No	2.5	--
San Pedro Parks	Annual	0.0112	0.0099	0.0169	0.0169	0.1	No	2.5	--
West Elk	Annual	0.0016	0.0010	0.0010	0.0016	0.1	No	2.5	--
Weminuche	Annual	0.0062	0.0086	0.0059	0.0086	0.1	No	2.5	--
Wheeler Peak	Annual	0.0021	0.0014	0.0028	0.0028	0.1	No	2.5	--

4.3.2 Regional haze impacts with full-year MM5 databases

Results of the regional haze impacts from the proposed Project are provided in Table 4-5. The results are presented in terms of the change in light extinction from natural background extinction as provided in the FLAG (2000) guidance (Method 2) as well as with an alternative Method 6 approach with the 98 percentile results tabulated. The Method 6 results are presented as an alternative so that the sensitivity of the results to very high relative humidity that could be associated with natural meteorological interferences is reduced. The percentile statistic is used, consistent with the BART approach, to set aside outlier events as mentioned in the final EPA BART rule signed on June 15, 2005.

Table 4-6 shows an alternative set of regional haze results using a lower background ammonia concentration (0.1 ppb instead of 0.2 ppb) for cold-weather months (November – March) in light of limited measurements showing that this alternative value is reasonable, and to indicate the sensitivity of the results to this input value. Table 4-7 shows another set of alternative regional haze results with the AERMOD-like dispersion option selected.

The results in Table 4-5 show that 2001 is the worst-case year. For Method 2 (FLAG approach), there are a number of Class I areas with several days of modeled extinction above 5% change. Over all years and Class I areas, there are no more than 2 days in any year with modeled extinction changes over 10% for the Method 2 approach, with the peak impact under 20% change. The Method 6 results in Table 4-5 show that there is no more than 1 day per year, if any, at any 1 Class I area per year with modeled impacts over 10%. There is only one Class I area, Mesa Verde, with the 98 percentile impact only slightly above 5% for any given year, and the 3-year aggregate 98 percentile impact just slightly above a 5% change (equivalent to 0.51 deciviews). The BART approach indicates that the project's impacts are marginally noticeable at only one Class I area.

Time series plots of the daily peak extinction change for selected Class I areas are presented in Appendix B. These plots indicate that the majority of the peak impact days occur in the cold weather months. An examination of the CALPOST output for these predicted impacts shows that the contribution of nitrates to the total extinction is almost always higher than the sulfates. This is likely due to the sensitivity of the CALPUFF nitrate chemistry to temperature and humidity, as illustrated in Figure 4-3. However, IMPROVE monitoring in Class I areas on the Colorado plateau show a much higher contribution of sulfates to extinction than nitrates, as illustrated in Figure 4-4 (see http://vista.cira.colostate.edu/views/Web/GraphicViewer/seasonal.htm).

It is important to realize that the nitrate chemistry is sensitive to the ambient ammonia concentration, which is also temperature sensitive. The modeling protocol addendum (Appendix A) discusses this issue and alludes to a sensitivity test with lower ammonia background in cold weather months. The results of selecting 0.1 ppb for ammonia concentrations in the months of November–March are presented in Table 4-6. These results show lower impacts for both Methods 2 and 6. The Method 6 results have only one predicted extinction change barely over 10%, and the 98 percentile results show all Class I areas with the 3-year aggregate extinction change below 5%. For Mesa Verde, there is one year with the 98 percentile extinction change barely over 5%.

Due to the technical advances available with the turbulence-based dispersion option, we decided to show the results with this feature (MDISP = 2, MPDF = 1) in Table 4-7, with no change in background ammonia from the base case. For Method 2, these results show no more than 1 day per year with predicted extinction change above 10% at any Class I area. The Method 6 results show all predicted extinction changes below 10%, and the 98 percentile extinction changes below 5% for all Class I areas in all years.

Table 4-5 Regional haze modeling results (2001-2003) – ISC-type dispersion

Class I Area	2001			2002			2003		
	Days > than		MAX % Change in B_{ext}	Days > than		MAX % Change in B_{ext}	Days > than		MAX % Change in B_{ext}
	5% ΔB_{ext}	10% ΔB_{ext}		5% ΔB_{ext}	10% ΔB_{ext}		5% ΔB_{ext}	10% ΔB_{ext}	
Method 2, EPA f(RH), FLAG Background									
Arches	5	0	**9.09**	1	0	**6.19**	0	0	4.21
Bandelier	3	0	**8.94**	0	0	3.73	2	0	**6.64**
Black Cany. Gun.	2	0	**5.77**	0	0	3.11	0	0	4.02
Canyonlands	6	2	**18.28**	0	0	4.61	1	0	**5.87**
Capitol Reef	7	1	**11.69**	0	0	4.83	0	0	4.33
Grand Canyon	1	0	**8.77**	1	0	**9.17**	0	0	4.29
Great Sand Dunes	0	0	2.86	0	0	3.68	0	0	3.16
La Garita	0	0	4.91	0	0	3.56	0	0	2.25
Mesa Verde	15	1	**12.52**	15	2	**16.81**	2	1	**10.91**
Pecos	0	0	4.64	0	0	2.99	0	0	4.75
Petrified Forest	2	1	**11.34**	1	0	**9.00**	0	0	3.25
San Pedro Parks	5	1	**11.61**	1	0	**5.02**	7	1	**11.35**
West Elk	2	0	**6.94**	0	0	3.51	0	0	3.91
Weminuche	4	1	**10.35**	3	0	**6.67**	2	0	**6.40**
Wheeler Peak	0	0	3.23	0	0	2.84	0	0	4.74

Method 6, Monthly f(RH), FLAG Background

Class I Area	2001			2002			2003			2001-2003	
	Days > than		MAX % Change in B_{ext}	Days > than		MAX % Change in B_{ext}	Days > than		MAX % Change in B_{ext}	8th High % Change in B_{ext}	22nd Highest % Change in B_{ext}
	5% ΔB_{ext}	10% ΔB_{ext}		5% ΔB_{ext}	10% ΔB_{ext}		5% ΔB_{ext}	10% ΔB_{ext}			
Arches	1	0	**5.10**	1	0	**6.19**	0	0	4.21	2.80	2.46
Bandelier	0	0	4.13	0	0	3.45	1	0	**5.20**	2.45	2.07
Black Cany. Gun.	0	0	4.09	0	0	3.35	0	0	3.60	2.05	1.74
Canyonlands	6	1	**13.37**	4	0	**6.28**	1	0	**6.71**	4.03	3.08
Capitol Reef	2	0	**6.10**	0	0	4.29	1	0	**5.42**	3.28	2.87
Grand Canyon	0	0	4.77	1	0	**5.69**	0	0	4.70	1.50	1.25
Great Sand Dunes	0	0	2.38	0	0	4.31	0	0	2.51	1.50	1.16
La Garita	0	0	3.88	0	0	2.13	0	0	2.42	2.01	1.61
Mesa Verde	16	0	**7.97**	10	0	**9.68**	1	1	**11.58**	**6.36**	**5.18**
Pecos	0	0	2.88	0	0	2.88	0	0	4.77	2.05	1.79
Petrified Forest	1	0	**6.06**	1	0	**7.44**	1	0	**5.37**	1.83	1.64
San Pedro Parks	3	0	**6.19**	0	0	4.83	3	0	**8.65**	3.71	3.24
West Elk	0	0	4.09	0	0	2.68	0	0	3.70	1.69	1.48
Weminuche	1	0	**5.15**	0	0	4.83	0	0	3.32	2.89	2.76
Wheeler Peak	0	0	3.26	0	0	2.42	0	0	3.41	1.43	1.42

Table 4-6 Regional haze modeling results (2001-2003) –lower cold-season background ammonia concentration

Class I Area	2001			2002			2003		
	Days > than		MAX % Change in B_{ext}	Days > than		MAX % Change in B_{ext}	Days > than		MAX % Change in B_{ext}
	5% ΔB_{ext}	10% ΔB_{ext}		5% ΔB_{ext}	10% ΔB_{ext}		5% ΔB_{ext}	10% ΔB_{ext}	
Method 2, EPA f(RH), FLAG Background									
Arches	5	0	**8.82**	1	0	**5.63**	0	0	3.84
Bandelier	3	0	**8.18**	0	0	3.52	1	0	**6.07**
Black Cany. Gun.	0	0	4.87	0	0	2.74	0	0	3.08
Canyonlands	5	2	**14.16**	0	0	3.77	1	0	**5.77**
Capitol Reef	5	1	**10.06**	0	0	4.83	0	0	3.80
Grand Canyon	1	0	**7.76**	1	0	**8.26**	0	0	3.98
Great Sand Dunes	0	0	2.72	0	0	3.09	0	0	3.10
La Garita	0	0	4.91	0	0	3.56	0	0	2.25
Mesa Verde	13	0	**8.84**	11	1	**12.98**	2	0	**7.66**
Pecos	0	0	4.40	0	0	2.81	0	0	4.31
Petrified Forest	2	1	**10.19**	1	0	**7.58**	0	0	2.86
San Pedro Parks	4	1	**10.00**	0	0	4.49	6	1	**10.20**
West Elk	1	0	**6.34**	0	0	3.36	0	0	3.22
Weminuche	3	0	**8.60**	2	0	**6.67**	1	0	**5.87**
Wheeler Peak	0	0	2.82	0	0	2.62	0	0	4.65

Method 6, Monthly f(RH), FLAG Background

Class I Area	2001			2002			2003			2001-2003	
	Days > than		MAX % Change in B_{ext}	Days > than		MAX % Change in B_{ext}	Days > than		MAX % Change in B_{ext}	8th High % Change in B_{ext}	22th Highest % Change in B_{ext}
	5% ΔB_{ext}	10% ΔB_{ext}		5% ΔB_{ext}	10% ΔB_{ext}		5% ΔB_{ext}	10% ΔB_{ext}			
Arches	0	0	4.88	1	0	**5.63**	0	0	3.84	2.42	2.15
Bandelier	0	0	3.77	0	0	3.00	0	0	4.59	2.15	1.96
Black Cany. Gun.	0	0	3.68	0	0	2.88	0	0	2.73	1.84	1.50
Canyonlands	5	1	**10.07**	1	0	**5.47**	1	0	**5.08**	3.19	2.68
Capitol Reef	1	0	**5.27**	0	0	3.76	0	0	4.13	2.90	2.30
Grand Canyon	0	0	4.26	1	0	**5.15**	0	0	4.23	1.40	1.08
Great Sand Dunes	0	0	2.04	0	0	3.44	0	0	2.31	1.33	1.09
La Garita	0	0	3.88	0	0	2.02	0	0	2.42	2.01	1.47
Mesa Verde	10	0	**6.74**	5	0	**7.63**	1	0	**7.86**	**5.18**	4.50
Pecos	0	0	2.55	0	0	2.49	0	0	4.30	1.83	1.64
Petrified Forest	1	0	**5.49**	1	0	**6.30**	0	0	4.64	1.81	1.55
San Pedro Parks	2	0	**5.30**	0	0	3.95	1	0	**7.44**	3.59	2.96
West Elk	0	0	3.69	0	0	2.42	0	0	2.99	1.57	1.39
Weminuche	0	0	4.31	0	0	3.99	0	0	2.90	2.76	2.53
Wheeler Peak	0	0	2.49	0	0	2.23	0	0	2.91	1.28	1.28

Table 4-7 Regional haze modeling results (2001-2003) – AERMOD-type dispersion

Class I Area	2001			2002			2003		
	Days > than		MAX % Change in B_{ext}	Days > than		MAX % Change in B_{ext}	Days > than		MAX % Change in B_{ext}
	5% ΔB_{ext}	10% ΔB_{ext}		5% ΔB_{ext}	10% ΔB_{ext}		5% ΔB_{ext}	10% ΔB_{ext}	
Method 2, EPA f(RH), FLAG Background									
Arches	5	0	**8.40**	1	0	**5.30**	1	0	**5.51**
Bandelier	2	0	**6.58**	0	0	3.06	1	0	**5.88**
Black Cany. Gun.	2	0	**5.89**	0	0	3.43	0	0	3.30
Canyonlands	6	1	**13.61**	0	0	3.57	1	0	**8.71**
Capitol Reef	5	1	**10.67**	1	0	**6.38**	0	0	3.72
Grand Canyon	2	0	**9.93**	1	0	**8.30**	0	0	3.13
Great Sand Dunes	0	0	2.85	0	0	3.43	0	0	4.83
La Garita	0	0	4.78	0	0	3.34	0	0	1.95
Mesa Verde	1	0	**5.83**	5	0	**8.93**	1	0	**5.85**
Pecos	0	0	3.67	0	0	2.54	1	0	**5.03**
Petrified Forest	1	1	**10.68**	1	0	**5.38**	0	0	2.50
San Pedro Parks	2	0	**8.51**	0	0	3.42	4	0	**6.07**
West Elk	3	1	**12.21**	0	0	3.34	0	0	3.43
Weminuche	1	0	**5.04**	0	0	4.14	1	0	**5.92**
Wheeler Peak	0	0	2.81	0	0	2.29	0	0	4.84

Method 6, Monthly f(RH), FLAG Background

Class I Area	2001			2002			2003			2001-2003	
	Days > than		MAX % Change in B_{ext}	Days > than		MAX % Change in B_{ext}	Days > than		MAX % Change in B_{ext}	8th High % Change in B_{ext}	22th Highest % Change in B_{ext}
	5% ΔB_{ext}	10% ΔB_{ext}		5% ΔB_{ext}	10% ΔB_{ext}		5% ΔB_{ext}	10% ΔB_{ext}			
Arches	0	0	4.70	1	0	**5.30**	1	0	**5.51**	2.68	2.38
Bandelier	0	0	3.31	0	0	2.41	0	0	4.61	2.13	1.91
Black Cany. Gun.	1	0	**5.05**	0	0	3.83	0	0	3.35	1.74	1.59
Canyonlands	4	0	**7.12**	1	0	**5.10**	0	0	4.84	4.08	3.25
Capitol Reef	1	0	**5.68**	0	0	3.52	0	0	4.35	2.75	2.37
Grand Canyon	1	0	**5.31**	1	0	**5.19**	0	0	3.77	1.32	1.14
Great Sand Dunes	0	0	2.05	0	0	4.00	0	0	4.01	1.55	1.22
La Garita	0	0	3.67	0	0	2.02	0	0	2.10	1.87	1.42
Mesa Verde	1	0	**5.29**	1	0	**5.10**	0	0	4.81	3.30	2.9
Pecos	0	0	2.35	0	0	1.95	0	0	3.85	1.97	1.76
Petrified Forest	1	0	**5.67**	0	0	4.44	0	0	4.26	1.90	1.59
San Pedro Parks	0	0	4.76	0	0	3.19	0	0	3.73	2.80	2.45
West Elk	1	0	**6.80**	0	0	3.31	0	0	3.70	1.75	1.5
Weminuche	0	0	3.92	0	0	3.77	1	0	**5.14**	2.14	2.07
Wheeler Peak	0	0	2.81	0	0	1.89	0	0	2.61	1.42	1.32

Figure 4-3 Example of dependence of nitrate equilibrium on temperature in CALPUFF

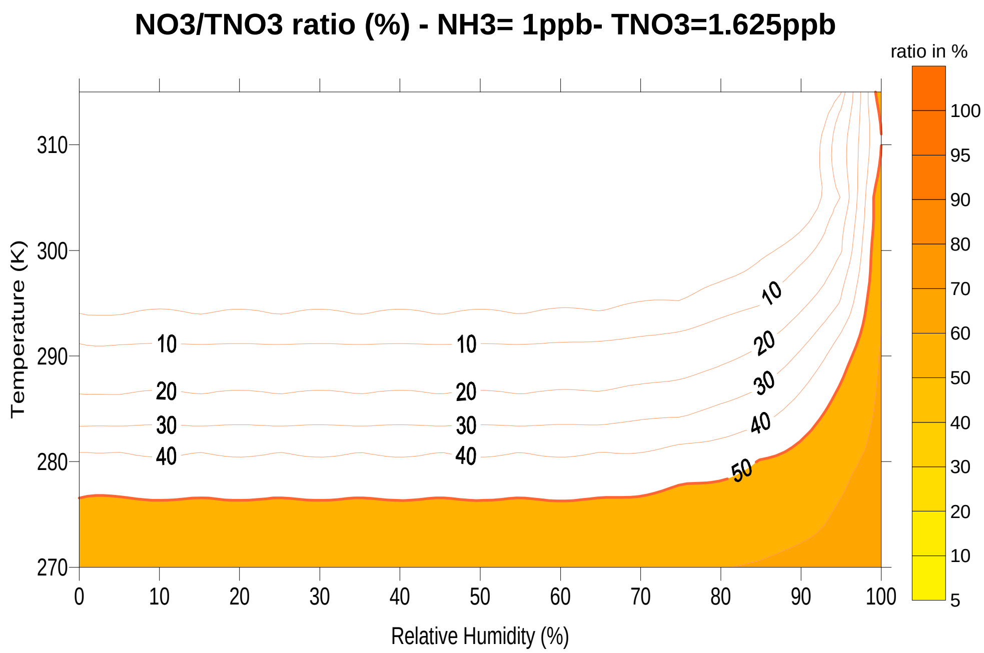
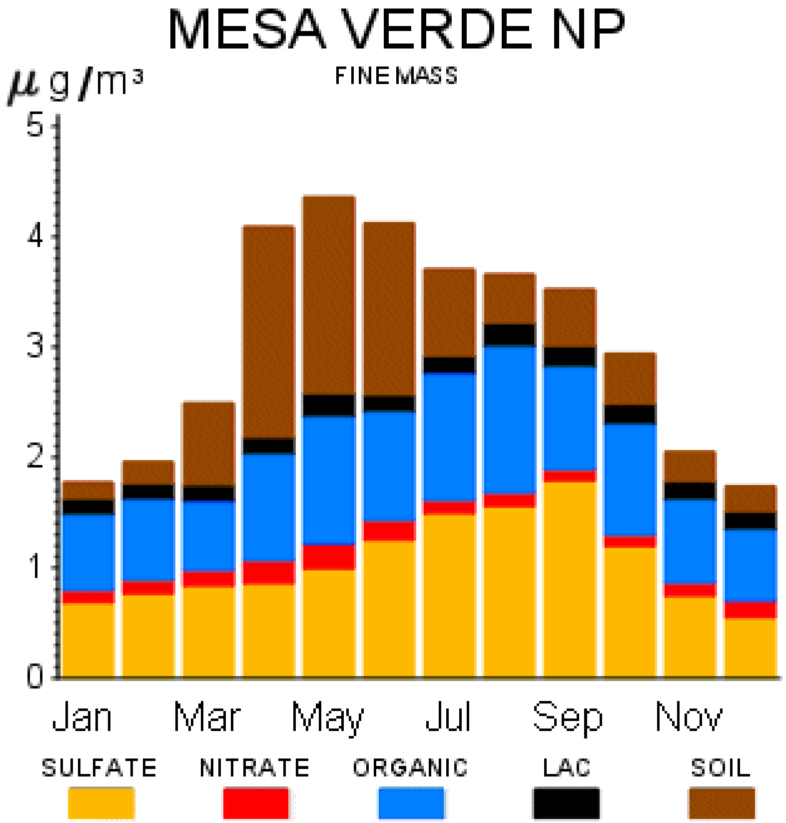


Figure 4-4 Monthly PM constituents at Mesa Verde National Park



4.3.3 Sulfur and nitrogen deposition analysis

Results of the sulfur and nitrogen deposition analysis due to emissions from the proposed source are provided in Table 4-8. The deposition values bolded in Table 4-8 are above the DAT levels, but well below the assumed cumulative factor of 25 that is assumed in the DAT specification.

Table 4-8 Total nitrogen and sulfur deposition results over three years (2001-2003)

Class I Area	Averaging Period	Modeled Deposition (kg/ha/yr)			Maximum Annual Deposition	NPS Class I DAT	Exceed the DAT?
		2001	2002	2003	(kg/ha/yr)	(kg/ha/yr)	Yes/No
Sulfur							
Arches	Annual	0.006	0.003	0.004	**0.006**	0.005	Yes
Bandelier	Annual	0.014	0.013	0.015	**0.015**	0.005	Yes
Black Cany. Gun.	Annual	0.009	0.007	0.004	**0.009**	0.005	Yes
Canyonlands	Annual	0.010	0.006	0.008	**0.010**	0.005	Yes
Capitol Reef	Annual	0.004	0.001	0.003	0.004	0.005	No
Grand Canyon	Annual	0.002	0.001	0.001	0.002	0.005	No
Great Sand Dunes	Annual	0.004	0.004	0.004	0.004	0.005	No
La Garita	Annual	0.006	0.007	0.005	**0.007**	0.005	Yes
Mesa Verde	Annual	0.029	0.024	0.020	**0.029**	0.005	Yes
Pecos	Annual	0.009	0.009	0.010	**0.010**	0.005	Yes
Petrified Forest	Annual	0.002	0.002	0.004	0.004	0.005	No
San Pedro Parks	Annual	0.022	0.017	0.022	**0.022**	0.005	Yes
West Elk	Annual	0.007	0.005	0.004	**0.007**	0.005	Yes
Weminuche	Annual	0.012	0.017	0.013	**0.017**	0.005	Yes
Wheeler Peak	Annual	0.007	0.006	0.008	**0.008**	0.005	Yes
Nitrogen							
Arches	Annual	0.003	0.001	0.002	0.003	0.005	No
Bandelier	Annual	0.006	0.005	0.006	**0.006**	0.005	Yes
Black Cany. Gun.	Annual	0.004	0.003	0.002	0.004	0.005	No
Canyonlands	Annual	0.004	0.002	0.003	0.004	0.005	No
Capitol Reef	Annual	0.003	0.001	0.001	0.003	0.005	No
Grand Canyon	Annual	0.001	0.001	0.001	0.001	0.005	No
Great Sand Dunes	Annual	0.002	0.002	0.002	0.002	0.005	No
La Garita	Annual	0.004	0.003	0.002	0.004	0.005	No
Mesa Verde	Annual	0.012	0.011	0.009	**0.012**	0.005	Yes
Pecos	Annual	0.004	0.004	0.004	0.004	0.005	No
Petrified Forest	Annual	0.001	0.001	0.002	0.002	0.005	No
San Pedro Parks	Annual	0.010	0.007	0.010	**0.010**	0.005	Yes
West Elk	Annual	0.004	0.002	0.002	0.004	0.005	No
Weminuche	Annual	0.006	0.008	0.006	**0.008**	0.005	Yes
Wheeler Peak	Annual	0.004	0.003	0.004	0.004	0.005	No

For Class I areas with predicted deposition impacts above the DAT, additional analyses in the form of Lake Acid Neutralizing Capacity (ANC) were performed to comply with anticipated requests of the NPS and Forest Service. Data input values needed to conduct the ANC analysis based upon CALPUFF modeled results were provided by the Forest Service. Sulfur and nitrogen deposition can impact lakes in and near Class I and sensitive Class II areas. The Forest Service provided ENSR with a screening procedure to calculate the change in lake acid neutralizing capacity (ANC) from a baseline value at several lakes chosen by the Forest Service within the modeling domain. The screening procedure used for this analysis is documented in Appendix C.

Table 4-9 lists the lakes included in the analysis and their monitored baseline acid neutralizing capacity in units of micro-equivalent per liter (µeq/l). The threshold values for change in ANC are as follows:

- If the baseline ANC > 25, up to a 10% change in ANC is allowed.
- If the baseline ANC < 25, up to a 1 µeq/l change in ANC is allowed.
- If the baseline ANC < 0, “no change” in ANC is allowed.

The results of the calculations are also presented in Table 4-9, and reflect the average increase over the three years modeled in micro-equivalents per liter or percent change of ANC. The results show little to no increase in the acid neutralizing capacity of these lakes.

Table 4-9 Baseline neutralizing capacity and potential changes for lakes in the modeling domain

Wilderness Area	Lake Name	UTM N	UTM E	Baseline ANC (µeq/l)	ANC Change (%)	Average ANC Change (µeq/l)
La Garita	Small Lake Above U-Shaped Lake	4,201,000	336,200	53.7	0.25	0.13
	U-Shaped Lake	4,200,850	336,500	65.3	0.20	0.13
South San Juan	Glacier	4,124,500	359,300	To be provided with Class II modeling update		
	Lake South of Blue Lakes	4,120,800	355,450			
Weminuche	Big Eldorado	4,176,679	275,801	27.7	0.42	0.12
	Little Eldorado	4,176,833	275,489	-2.4	9.60	0.19
	Lower Sunlight	4,168,037	272,111	79.8	0.36	0.29
	Upper Grizzly	4,166,642	271,756	24.3	1.24	0.30
	White Dome	4,176,293	275,042	2.3	8.40	0.19
West Elk	S. Golden	4,294,000	310,300	111	0.17	0.19

4.4 Supplemental regional haze analyses with special NPS MM5 data sets

The National Park Service has provided 4-km and 12-km MM5 data for the following periods (involving complete days of data):

- 2001: January 3 – January 29
- 2003: January 1 – January 16
- 2004: April 20 – May 1.

These periods were run only for the assessment of regional haze impacts because they were provided to ENSR due to specific concerns for that AQRV. Results for these periods were directly compared to the same periods with the full-year MM5 data for 2001 and 2003.

For these selected periods, 4-km MM5 data was not available at all PSD Class I areas within 300 km of the proposed project site, as shown in Figure 4-2. However the 12-km MM5 data does cover all of the Class I areas within 300 km of the project site. Therefore the selected periods mentioned above were run with 4-km MM5 data for:

- Canyonlands
- Capitol Reef
- Grand Canyon
- Mesa Verde
- Weminuche

Portions of these Class I areas that are either very close to the edge or outside of the 4-km MM5 data set or are greater than 300 km from the proposed source were not assessed with this grid. The 4-km MM5 runs were conducted with a 3-km CALMET grid resolution (except for Mesa Verde) and the domain depicted in Figure 4-2.

The remaining Class I areas were assessed using the 12-km MM5 for the same periods of interest. Those areas are as follows:

- Arches
- Black Canyon of the Gunnison
- Bandelier
- Great Sand Dunes
- La Garita
- Pecos
- Petrified Forest
- San Pedro Park
- West Elk
- Wheeler Peak

The 12-km MM5 runs were conducted with 4-km CALMET grid resolution and the original domain designed for this Project as depicted in Figure 4-2.

The modeling results using the 4 and 12-km NPS MM5 data are provided in Table 4-10 for each period of interest noted above. Only the ISC-type dispersion results were modeled for comparison to the base case used for the full-year MM5 runs. The peak impacts for the limited periods modeled are shown for the 4-km or 12-km MM5 data vs. the same periods for the full-year runs (when available).

For the period of January 2001, the 4-km MM5 results were lower than the 36-km results for every one of the five Class I areas within that domain. It is noteworthy that the peak impact at the Grand Canyon was less than half of the prediction with the 36-km MM5 data. For the first half of January in 2003, a similar reduction was seen in the predictions for the Grand Canyon. From these results, it appears that the introduction of more sophisticated meteorological data shows significantly lower impacts in the Grand Canyon, indicating that the coarser grid MM5 data sets appear to be showing more conservative results for that park in particular. In general, results for the 4-km grid at other parks in 2003, and results for the 12-km grid at the remaining parks were mixed. The predictions for the period of April 2004 showed no surprisingly high results, and the Grand Canyon impacts were quite low.

Overall, the use of the finer grid MM5 data led to lower impacts at the Grand Canyon, which was the park that concerned the National Park Service for missed predictions in this area. Otherwise, the limited data indicates a mixed result, with no notable trend toward overall higher or lower impacts, but rather a redistribution of impacts. It is noteworthy that for 2001, the year with the largest grid size for the MM5 data, the use of the finer grid data for MM5 consistently led to lower predictions. This trend suggests that with higher quality MM5 data, the predicted impacts are reduced.

Table 4-10 Regional haze results for 4-km MM5 data

Class I Area	January 3 - 30, 2001		January 1 - 16, 2003		April 4 - May 1, 2004
	MAX % Change in B_{ext}				
Method 2, EPA f(RH) Values, RHMAX=95, FLAG Background					
	4-km MM5	***36-km MM5***	***4-km MM5***	***20-km RUC***	***4-km MM5***
Canyonlands	9.67	12.34	2.90	2.79	0.20
Capitol Reef	4.89	11.69	2.53	1.64	0.05
Grand Canyon	4.14	8.77	1.58	4.29	0.23
Mesa Verde	7.49	7.61	3.62	3.30	5.11
Weminuche	2.94	4.25	7.91	3.80	1.18
	12-km MM5	***36-km MM5***	***12-km MM5***	***20-km RUC***	***12-km MM5***
Arches	11.46	9.09	1.29	1.13	0.14
Bandelier	15.05	8.94	3.53	5.69	0.85
Black Cany. Gun.	2.20	3.72	3.06	1.51	1.63
Great Sand Dunes	2.28	1.52	3.82	3.16	0.29
La Garita	2.81	3.21	2.43	1.10	0.66
Pecos	7.50	4.47	3.65	4.75	0.56
Petrified Forest	1.49	11.34	0.09	0.09	0.69
San Pedro Parks	10.67	11.61	4.61	8.98	1.36
West Elk	2.82	3.71	2.42	1.25	1.66
Wheeler Peak	1.01	1.59	1.79	3.03	0.33

4.5 Cumulative Class I increment modeling analysis

A cumulative SO_2 increment modeling analysis was performed because the project-only impacts were greater than the proposed Class I area SILs provided in Table 4-2. The background source inventory is listed in Table 4-11 (and included in Appendix A of the modeling protocol addendum).

Two coal-fired power plants, the San Juan Generating Station (SJGS) and the Four Corners Power Plant (FCPP), had emission units that were either operating or under construction as of the SO_2 major source baseline date of January 6, 1975. These units include all five of the FCPP boilers and units 1 and 2 of the SJGS. The determination of the baseline versus current emission differences for these units is discussed in the modeling protocol addendum (Appendix A) and also in the next section.

4.5.1 Background source inventory

Source data for the SO_2 cumulative increment analysis for the applicable PSD Class I areas were obtained from the entire modeling domain, following suggestions by the National Park Service (NPS), provided below. The source information used in the modeling was initially obtained from several sources (see the modeling archive):

- The National Park Service for three projects in Utah and New Mexico
- The state agencies in Utah, Colorado, Arizona, and New Mexico
- EPA's 1999 National Emissions Inventory
- Aerial/satellite photos, topographic maps, and eyewitness information for the Navajo Nation.

Agency communications and documents relating to the background emissions inventory assembled for the 2004 permit application submittal are provided in the modeling data archive (provided separately).

For the PSD Class I cumulative modeling, all PSD sources with emissions of at least 100 tpy were modeled for all applicable Class I areas, regardless of distance, as long as the sources were located inside the modeling domain. In addition, sources of at least 40 tpy between 50 and 100 km of a given Class I area were included, as well as sources larger than 0.8D within 50 km of a Class I area. The additional sources less than 100 tpy were small in number, so all sources were modeled for the Class I areas for simplicity in approach.

The National Park Service provided comments on the 2004 background inventory, specifically questioning some emission rates used for the larger sources, which are electrical generating units (EGUs). Scott Bohning of EPA Region 9 researched this question, and determined conservatively high SO_2 emission rates for EGUs based upon the following considerations:

- Hourly emissions were examined for the years 2003 and 2004, and the 99^{th} percentile hourly SO_2 emissions were selected for each year and each individual emission unit.
- The average of the 99^{th} percentile hourly emissions for each unit for 2003 and 2004 was selected as the emissions to model for each stack.
- For baseline units with no hourly emissions data available, the peak emissions were calculated from a ratio of the peak to mean emissions derived from the current (2003-2004) operation.
- This procedure sets aside the top 1% of hourly emissions as likely to be not representative of normal operation.
- The hourly emissions are conservatively high with respect to expected 3-hour and 24-hour averages.
- The emissions are also conservatively high for multiple-unit facilities in which all units are not operating at peak load simultaneously.

The cumulative analysis was conducted with these conservative features in mind, with the possibility of revisiting some of the conservative assumptions if necessary.

The PSD Class I inventory for the increment-affecting background SO_2 sources is provided in Table 4-11.

Table 4-11 PSD Class I SO_2 inventory

Facility Name	Lat (deg)	Long (deg)	Base El. (m)	2003-2004 99%tile Emissions (g/s)	Stack Height (m)	Stack Temp (K)	Exit Velocity (m/s)	Stack Diameter (m)
PSD Increment Consuming Sources								
Desert Rock	36.50	-108.55	1645.8	102.810	279.50	323.15	24.99	11.21
Cholla Unit 2	34.93	-110.30	1529.0	89.089	167.64	348.71	34.14	4.48
Springerville GS	34.32	-109.17	2128.0	1064.432	152.40	339.00	21.30	6.10
Abitibi Consolidated	34.50	-110.33	1844.0	43.650	65.23	380.37	18.35	3.66
AE Staley MFG	37.58	-106.09	2322.6	2.451	5.18	1273.00	20.80	0.10
Nixon Unit 1	38.63	-104.71	1676.4	220.322	140.21	422.59	19.62	5.33
Kinder Morgan	37.47	-108.79	2017.8	1.008	6.10	644.26	2.54	0.61
Cameo Station (current)	39.15	-108.32	1463.0	82.566	45.72	399.81	7.77	2.67
Nucla Station	38.24	-108.51	1694.7	69.466	65.53	408.15	23.34	3.66
Holcim-Florence	38.38	-105.02	1536.2	109.000	110.00	376.00	14.52	6.00
Holcim-Florence	38.38	-105.02	1536.2	44.900	110.00	356.00	13.99	1.70
Hunter Unit 2	39.17	-111.03	1723.6	103.210	182.88	329.26	17.82	7.32
Hunter Unit 3	39.17	-111.03	1723.6	92.767	182.88	322.04	16.63	7.32
Lisbon Flare	38.16	-109.28	1828.8	1.155	12.20	613.15	83.58	0.46
Lisbon Incinerator	38.16	-109.27	1828.8	38.800	64.98	736.76	7.35	1.83
Consolidated Constr.	36.71	-108.24	1638.3	4.299	12.80	427.59	19.60	1.036
San Juan GS Unit 3	36.80	-108.44	1614.9	264.835	121.92	322.04	15.85	8.534
San Juan GS Unit 4	36.80	-108.44	1614.9	299.264	121.92	322.04	15.85	8.534
Bloomfield Refinery	36.70	-107.97	1673.3	5.383	24.38	1273.15	20.12	0.305
Peabody Mustang	35.66	-107.91	2112.3	43.474	147.28	343.09	18.29	5.505
Tri-State Escalante	35.41	-108.08	2103.8	47.110	138.07	324.26	15.24	6.096
PSD Increment Expanding Sources[(1)]								
Cameo Station (baseline)	39.15	-108.32	1463.0	-79.254	12.65	416.5	2.29	45.72
San Juan Unit 1	36.80	-108.44	1614.9	-373.839	121.92	317.59	18.29	6.096
San Juan Unit 2	36.80	-108.44	1614.9	-348.371	121.92	317.59	18.29	6.096
Four Corners Unit 1	36.69	-108.48	1615.0	-79.627	76.20	327.59	18.29	5.36
Four Corners Unit 2	36.69	-108.48	1615.0	-67.202	76.20	327.59	18.29	5.36
Four Corners Unit 3	36.69	-108.48	1615.0	-62.855	76.20	327.59	31.63	4.36
Four Corners Unit 4	36.69	-108.48	1615.0	-162.148	115.82	333.15	23.89	8.69
Four Corners Unit 5	36.69	-108.48	1615.0	-109.897	115.82	333.15	18.29	8.69
1 Baseline peak emissions listed								

4.5.2 Cumulative Class I increment modeling results

The cumulative modeling results for Class I increment are presented in Table 4-12. The results in Table 4-12 include increment expansion principally from FCPP and SJGS units 1 and 2. The results show that cumulative impacts are well below the PSD Class I increments. Although the Project did not have significant annual impacts, the results of the annual average impacts using the short-term emission rates are provided for further discussion in the conclusions section. It is important to note that even with the project emissions included, the average annual impacts are negative with nearby source reductions through 2004 accounted for at several of the nearest Class I areas.

Table 4-12 PSD Class I SO_2 cumulative modeling results over 3 years (2001-2003)

Class I Area	Averaging Period	Modeled Concentrations ($\mu g/m^3$)			3-Year Max. Conc.	PSD Class I Increment	% of PSD Class I Increment
		2001	2002	2003	($\mu g/m^3$)	($\mu g/m^3$)	%
Bandelier	3-hr	6.76	5.98	3.27	6.76	25	27%
	24-hr	2.15	1.43	0.93	2.15	5	43%
	Annual	-0.006	0.019	0.054	0.054	2	3%
Canyonlands	3-hr	6.76	5.98	3.52	6.76	25	27%
	24-hr	2.15	1.43	1.07	2.15	5	43%
	Annual	0.054	0.070	0.097	0.097	2	5%
Mesa Verde	3-hr	11.70	11.30	12.84	12.84	25	51%
	24-hr	2.15	1.10	1.80	2.15	5	43%
	Annual	-0.116	-0.103	-0.034	-0.034	2	-2%
Petrified Forest	3-hr	16.38	13.45	12.76	16.38	25	66%
	24-hr	3.50	3.72	2.85	3.72	5	74%
	Annual	0.374	0.329	0.349	0.374	2	19%
San Pedro Parks	3-hr	2.54	2.28	2.21	2.54	25	10%
	24-hr	0.90	0.80	0.71	0.90	5	18%
	Annual	-0.033	-0.028	-0.093	-0.028	2	-1%
Weminuche	3-hr	2.12	2.07	3.51	3.51	25	14%
	24-hr	0.45	0.25	0.35	0.45	5	9%
	Annual	0.009	-0.001	0.005	0.009	2	0%

4.6 Summary of air quality modeling results

Dispersion modeling of the air quality impacts of the proposed Desert Rock Energy Facility has been completed for PSD Class I areas. The results are summarized below.

- The project impacts are above PSD Class I significance levels for SO_2 in a number of areas (including three PSD Class II areas that have special Colorado designation as Class I for SO_2). The Project has an insignificant impact for NO_2 and PM_{10} increment.
- The project's impact is a small fraction of the total PSD increment (slightly over 20% for SO_2 at most). The cumulative analysis shows that the Project does not cause or contribute to a PSD Class I increment violation, and that no Class I increment violations are predicted in the areas modeled. The 3-hour and 24-hour 3-year maximum SO_2 impacts are 66% and 74% of the PSD increments, respectively, at Petrified Forest (mainly due to local sources in that area).
- The project's impacts on sulfur and nitrogen deposition are higher than the DAT levels that trigger additional review in a few areas. However, the annual cumulative SO_2 impacts shown in Table 4-12 indicate that with other emission reductions as of 2004, there is a reduction in the deposition load for many

of these areas. It is noteworthy to account for additional large reductions in SO_2 and NO_x emissions being undertaken at the nearby San Juan Generating Station, fully effective by the year 2010, relative to emissions in 1999:

- SO_2 annual emissions reduced by nearly 7,000 TPY (vs. about 3,300 TPY Desert Rock)
- NO_x annual emissions reduced by about 7,000 TPY (vs. about 3,300 TPY Desert Rock)
- PM_{10} annual emissions reduced by nearly 2,500 TPY (vs. about 1,100 TPY Desert Rock).

In addition, recent changes in emissions at the nearby Four Corners Power Plant are also important to account for in the cumulative impact evaluation. These changes appear to be voluntary SO_2 emission reductions throughout 2004 due to increased scrubbing efficiency, and can be seen from data posted on the EPA's Acid Rain Database. Annual SO_2 emissions appear to be dropping from about 35,000 TPY to about 15,000 TPY, a reduction of some 20,000 TPY.

It is clear from the above tallies of emission reductions in the Four Corners area that an overall reduction in acidic deposition is expected. This further indicates that the minimal Lake ANC impacts would be further reduced.

For regional haze,

- The project's impacts on regional haze are above the significance threshold of 5% change to background extinction with the use of the FLAG screening procedures and Method 2. The Method 6 results with P-G coefficients indicate that the 98 percentile day has impacts only marginally higher than a 5% change in extinction only at Mesa Verde.
- The results of the sensitivity run with a lower background ammonia concentration during cold weather months show lower impacts, and with the Method 6 results for the 98 percentile day showing one area, Mesa Verde, at the significance threshold and all other areas below that threshold.
- The results of the sensitivity run with turbulence-based dispersion also shows lower impacts than the base case, and the Method 6 results for the 98 percentile day showing all years and areas below the 5% significance threshold.
- The modeling with a finer MM5 grid shows consistently lower impacts for the worst-case year (at least for January), suggesting that better MM5 data may lead to lower predicted impacts. The finer grid MM5 data consistently led to lower impacts at the Grand Canyon than the coarser grid MM5 did.
- The discussion above regarding current plans to reduce emissions from the adjacent plants (FCPP and SJGS) with amounts higher than the proposed project emissions indicates that any cumulative regional haze analysis would result in lower impacts than these reported above, and most likely negative impacts due to the overwhelming levels of emission reductions. The cumulative SO_2 increment results for Mesa Verde, for example indicate that with emission reductions as of 2004, there would be, on average, negative impacts for sulfates on a cumulative basis, and this accounts for a large portion of the extinction, as shown in Figure 4-4. With the additional emission reductions being planned by the year 2010, the visibility improvements will be further enhanced, even accounting for the proposed project emissions.

In conclusion, the potential effects on air quality and air quality related values analyzed here due to emissions from the proposed Desert Rock Energy Facility, especially in conjunction with the nearby srouce emission reductions, are expected to result in no adverse impacts.

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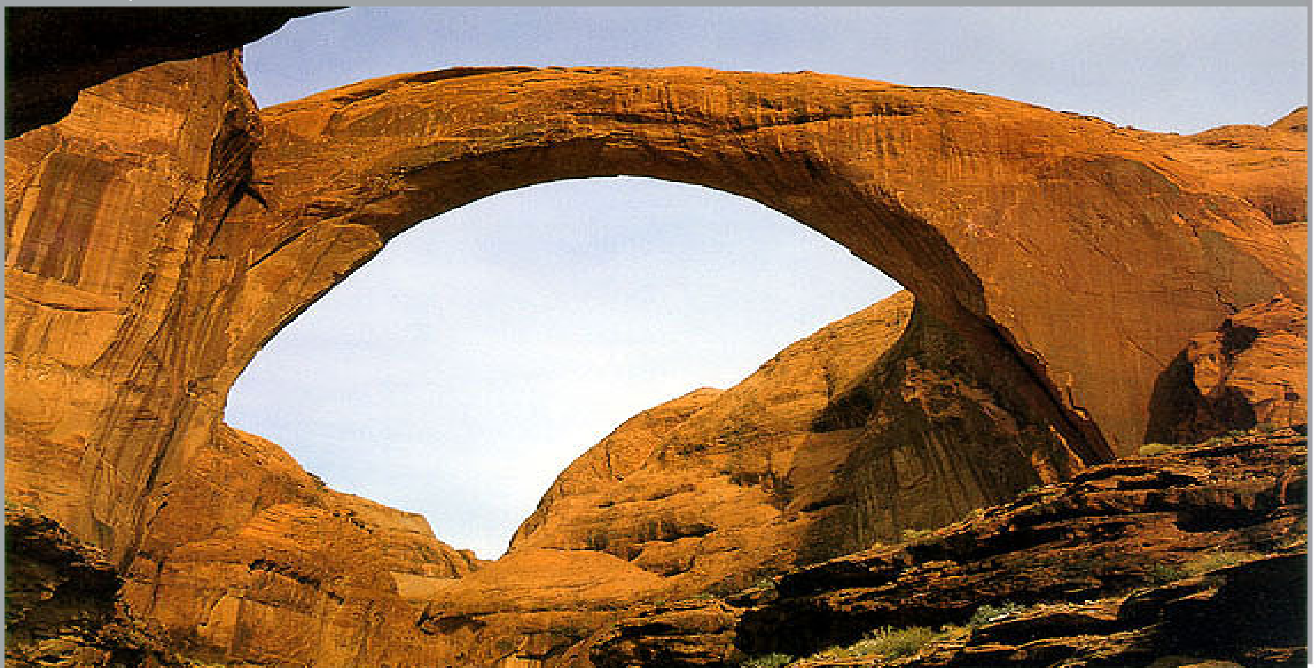
Appendix A

Addendum to Modeling Protocol for the Proposed Desert Rock Generating Station

Prepared for:
Sithe Global Power, LLC
Houston, TX



Addendum to Modeling Protocol for the Proposed Desert Rock Generating Station

ENSR Corporation
January 2006
Document No.: 10784-001-0003

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Prepared for:
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Addendum to Modeling Protocol for the Proposed Desert Rock Generating Station

Prepared By: Jeffrey A. Connors

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ENSR Corporation
January 2006
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1.0 Introduction

1.1 Background

In May, 2004, Steag, LLC (now Sithe Global Power, LLC) submitted a Prevention of Significant Deterioration (PSD) permit application to EPA Region 9 associated with a modeling protocol and modeling analysis for assessing the air quality impacts of the proposed Desert Rock Generating Station. This project is a mine-mouth coal-fired power plant, to be located in northwestern New Mexico about 50 km southwest of Farmington, New Mexico, within the trust lands of the Navajo Nation. The plant will receive its coal supplies from BHP Billiton New Mexico Coal.

The modeling analysis submitted in May 2004 used the CALPUFF (Scire et al., 2000) model for both short-range and long-range transport modeling. While CALPUFF is the preferred EPA model for long-range transport (distances of at least 50 km), it is also used on a case-by-case basis for local complex winds. The results of a 1982 study focusing upon meteorological conditions in northwestern New Mexico provided evidence that the local flows exhibit complex behavior. Therefore, EPA Region 9 approved the use of the CALPUFF model with a 3-year meteorological database (2001-2003) for evaluating impacts on a consistent basis at all distances. This general modeling approach will not be changing for future modeling of the facility, except that a finer grid mesh may be employed for the local modeling near the proposed project site (including the local Class II modeling as well as Class I impacts at Mesa Verde; see Section 3-1). However, the National Park Service has elected to add three specific periods (more details in Section 3.3) to the analysis for regional haze at PSD Class I areas.

The two proposed units will exhaust to a common stack which will be built to the Good Engineering Practice (GEP) height of 279.5 meters (917 feet). For long-range transport modeling at distant (beyond 50 km) PSD Class I and sensitive Class II areas, the emissions from this main stack only were modeled in the 2004 submittal. Future modeling will use these same procedures for distant Class I and sensitive Class II areas. For short-range modeling (at distances within 50 km of the project site), emissions from fugitive sources and other intermittent and low-level combustion sources were also considered in the 2004 submittal and will be included in future local Class II modeling.

1.2 Overview of past modeling results

The short-range modeling of the project emissions (modeled for both minimum and maximum boiler loads) indicated a significant impact for two criteria pollutants: SO_2 and PM_{10}. The significant impact areas were contained within the Navajo Nation lands. A cumulative inventory was obtained for the area extending out 50 km from the distance to the Significant Impact Area (SIA). All sources in this inventory were modeled, along with the proposed source, except for very small sources with an emission rate in tons per year (TPY) less than 0.8D (D in km) from the extent of the SIA for SO_2, and 0.3D for PM_{10}. (This exclusion of very small sources is consistent with the approach used for the cumulative inventory for PSD Class I modeling, and equates to 40 TPY for SO_2 and 15 TPY for NO_x at a distance of 50 km.) The cumulative modeling results showed compliance by a wide margin for the National Ambient Air Quality Standards (NAAQS) and the PSD increments.

Long-range modeling (for transport distances beyond 50 km) was conducted for both mandatory PSD Class I areas and also several sensitive Class II areas of interest to the National Park Service and the Forest Service. The Class II results were well below applicable thresholds for increment consumption and increment significance levels. The Class I results were significant for SO_2 only. A modeling analysis with a cumulative inventory was conducted, after an inventory was requested from New Mexico, Colorado, Utah, and Arizona. For two nearby sources (San Juan Generating Station and Four Corners Power Plant), increment-expanding emissions were also considered. The modeling results showed compliance for total SO_2 increment consumption in all Class I areas.

Regional haze modeling was first conducted using the default FLAG approach. Some alternative methods were also applied to account for meteorological interferences, other components of natural background (e.g., natural salt concentrations), and EPA's revised f(RH) curves used in the implementation of the Regional Haze Rule. The result of one of the alternative approaches, which included a detailed analysis of meteorological interference periods and an hourly ratio averaging approach, resulted in an insignificant modeled impact for the proposed facility. The permit application was submitted with the conclusion that the proposed project will not have an adverse impact on regional haze.

Acidic deposition results were also provided as part of the permit application. Although the results were above the deposition analysis thresholds (DATs), these thresholds incorporate a conservative factor of 25 for source clustering, and the results of the modeling showed impacts that were well below that margin.

1.3 Comments on permit application air quality analysis

A summary of comments received on the air quality modeling analysis in the 16 months since the permit application was filed is provided below. Several comments were received regarding the PSD Class I modeling, and very few regarding the Class II (local) modeling. The comments discussed below refer mostly to the Class I modeling issues, and were primarily submitted by the National Park Service.

- Minor source baseline dates need to be identified before a cumulative analysis is conducted.
- The validity of sources in the cumulative inventory is questionable. Some of the emission rates used may be too low. Also, there is a question as to whether minor sources have been accounted for.
- It is not clear whether the increment expansion sources modeled for the Class I SO_2 cumulative inventory are fully creditable.
- The visibility impact analysis resulted in a conclusion of insignificant impacts, but the alternative procedures used in that conclusion are questioned by the National Park Service, such as the way the meteorological interferences were addressed and the quantification of the natural salt particle influence on natural background.
- The meteorological data used in the analysis was not properly evaluated.
- Some of the CALPUFF model system technical options selected need more justification, such as the dispersion option.
- For regional haze, there is a concern about winter events with an easterly wind that could advect the project emissions to the Grand Canyon, have these emissions pass through (and possibly stagnate within) a cloud layer within the Canyon, accelerate formation of a sulfate cloud, and cause a visibility impairment that is under-predicted by CALPUFF. To address this problem, a meteorological wind field with a resolution of 4-12 km is needed. In addition, there is concern that CALPUFF is understating the sulfate transformation inside clouds. On the other hand, ENSR noticed that CALPUFF appears to be overstating the nitrate formation in winter due to its dominance relative to sulfate formation in cold weather, while IMPROVE observations indicated dominance of sulfates rather than nitrates.
- Since the FLAG method did not show low impacts for the proposed facility, a refined analysis must be undertaken to resolve the predicted project impacts.
- The protocol we have discussed to date has really only dealt with the Desert Rock impacts in isolation. The issue of methods for a cumulative impact assessment is not covered. We expect that a cumulative assessment will still be done.
- We want to be clear that the modeling protocol as currently presented will not satisfy two of our primary concerns. First, there is still no consideration of aqueous phase conversion of sulfates.

> Secondly, the meteorological fields proposed for use are still unlikely to capture some of the important flow phenomena that lead to impacts in the Class I areas in the region. We are attempting to generate more accurate wind fields for some specific time periods, and will make them available to you as soon as they are available. We anticipate looking at these results as well as refining previous work done at the NPS when making our recommendations. We will need copies of all of the CALPUFF input and output files to complete our evaluations.

The next two sections discuss a resolution to these comments and how the next round of modeling will be conducted.

2.0 Resolution of comments regarding the modeling analysis

This section presents each comment stated above, and then provides a discussion regarding a response to the comment.

1. Minor source baseline dates need to be identified before a cumulative analysis is conducted.

Discussion: these dates have been assembled by WESTAR and are available at http://www.westar.org/Committees/TDocs/AQCR%20maps/SO2_02Dec04.pdf. The emission inventories already supplied by each state are consistent with these dates.

2. The validity of sources in the cumulative inventory is questionable. Some of the emission rates used may be too low. Also, there is a question as to whether minor sources have been accounted for.

Discussion: The cumulative emission inventories are most likely overstating increment consumption because increment expanding sources (other than perhaps San Juan Generating Station and Four Corners Power Plant) are not included. In addition, the implementation of the on-road ultra-low diesel sulfur fuel program in 2006 and off-road diesel program in the 2007-2010 time frame. As Scott Bohning indicated in his April 29, 2005 notes for the May 3, 2005 meeting, the “states seem to agree that minor source growth does not pose a problem for SO_2 increment.”

For the Electric Generation Unit (EGU) sources in the inventory that already exist, EPA Region 9 has conducted a thorough review of the emissions, and has determined that the use of the 99th percentile emission rate will be sufficiently conservative so as to estimate the maximum routine operations. The EPA analysis is further described in Section 3.

3. It is not clear whether the increment expansion sources modeled for the Class I SO_2 cumulative inventory are fully creditable.

Discussion: This issue has been resolved by EPA Region 9, and is further discussed in Section 3 and Appendix A.

4. The visibility impact analysis resulted in a conclusion of insignificant impacts, but the alternative procedures used in that conclusion are questioned by the National Park Service, such as the way the meteorological interferences were addressed and the quantification of the natural salt particle influence on natural background.

Discussion: There has been an evolution of techniques that have been proposed and discussed to deal with the issue of meteorological interferences. This is an important issue because the peak modeled visibility impacts using the default FLAG approach can often occur during high relative humidity conditions, and these conditions can often be associated with natural obscuration such as fog, snow, rain, etc. These factors are not taken into account in CALPOST. The problem with procedures that attempt to address these conditions on a case-by-case basis is that the required analysis resources are extensive and the information regarding actual obscuration is often incomplete. Therefore, significant disagreements can occur regarding how to handle individual events.

An alternative approach to a case-by-case meteorological interference analysis is to adopt the method in EPA’s final BART rules for determining whether an existing source has an adverse visibility impact on any Class I area. That approach involves the following method:

a. Use Method 6 in CALPOST, which uses monthly average relative humidity values in the f(RH) calculation.

b. For each year (or over 3 years), take the 98% highest daily impact at any point in the Class I area to compare to a 0.5 deciview (or 5% extinction change) threshold for significance. For a one-year analysis, this would involve looking at the 8th highest day's impact at each receptor, while for a three-year analysis, it would involve the 22nd highest over the entire period.

5. The meteorological data used in the analysis was not properly evaluated.

Discussion: A comparison of the meteorological data at several surface airport stations was submitted with the permit application. However, some changes to the meteorological data are being proposed that will adopt publicly available data that have been independently reviewed. For 2001, we will use the 36-km data documented by McNally (2003). For 2002, we will use the recently-completed WRAP 12-km MM5 database, as documented by ENVIRON and UC Riverside (2004). For 2003, we will continue to use the 20-km RUC data, provided by Earth Tech. Three additional periods provided by the FLMs for a review of specific regional haze impacts will also be included.

6. Some of the CALPUFF model system technical options selected need more justification, such as the dispersion option. We would like to see CALPUFF run with the P-G dispersion option as our preferred choice. If the applicant uses the AERMOD-like MDISP=2 option only, the National Park Service will rerun CALPUFF with MDISP=3, thus delaying the review of the permit application.

Discussion: There has been extensive discussion of these options, and we have come to an agreement with the National Park Service. The agreed-upon options are listed in Section 3.

Additional information regarding the dispersion option is provided here. An EPA study available at http://www.epa.gov/scram001/7thconf/calpuff/tracer.pdf presents a comparison of CALPUFF predictions vs. observations for some far-field experiments and has mixed conclusions about the two dispersion options mentioned above. In the main report, the figures showing the crosswind concentration distributions predicted by CALPUFF with MDISP=2 and MDISP=3 overall show that when there are differences, the peak predictions are higher for MDISP=3, but that the MDISP=2 peak predictions generally have a better agreement with the observed peak values. This can be seen most clearly in Figure 3 and in Figure 4a (two different experiments). The Appendix A to the EPA report seems to provide a reverse conclusion for one experiment, showing overpredictions with the similarity dispersion curves and better agreement with the P-G curves. Therefore, there are mixed results reported here for the tendency of the two different options to predict higher or lower relative to each other for long-range transport, although two different experiments showed better performance with MDISP=2. In general, the choice of MDISP=2 does not appear to lead to underpredictions of the peak impact, and it is more accurate most of the time.

It is also noteworthy that the model developer, Earth Tech presents in its CALPUFF courses (Scire, 2005) the following features of the Pasquill-Gifford coefficients vs. the turbulence-based dispersion coefficients:

The P-G dispersion coefficients:

- are based on ground-level releases over short distances
- neglect variation of diffusion with height
- neglect variation of diffusion due to surface characteristics (except urban/rural distinction).

The turbulence-based dispersion coefficients:

- are continuous functions of height, surface properties, and measured or estimated values of σ_v, σ_w

- include spatial variability in dispersion rates; puffs respond to surface characteristics as they move
- respond to changes in surface roughness, soil moisture, and other surface parameters.

We do not have any further technical justification from the National Park Service regarding their choice of MDISP = 3, an option that is associated with a model (ISC) that is now being phased out by EPA. Accordingly, we will present results with MDISP = 3, but may include results as well with MDISP=2 (and MPDF=1) in some cases, especially for regional haze results, to provide more complete information for the reviewers.

7. For regional haze, there is a concern about winter events with an easterly wind that could advect the project emissions to the Grand Canyon, have these emissions pass through (and possibly stagnate within) a cloud layer within the Canyon, accelerate formation of a sulfate cloud, and cause a visibility impairment that is under-predicted by CALPUFF. Such impairment is typically seen after the clouds evaporate, and is usually limited to 24 hours or less. To address this issue, the FLMs feel that a meteorological wind field with a resolution of 4-12 km is needed. In addition, there is concern that CALPUFF is understating the sulfate transformation inside clouds. On the other hand, ENSR noticed that CALPUFF appears to be overstating the nitrate formation in winter due to its dominance relative to sulfate formation in cold weather, while IMPROVE observations indicated dominance of sulfates rather than nitrates.

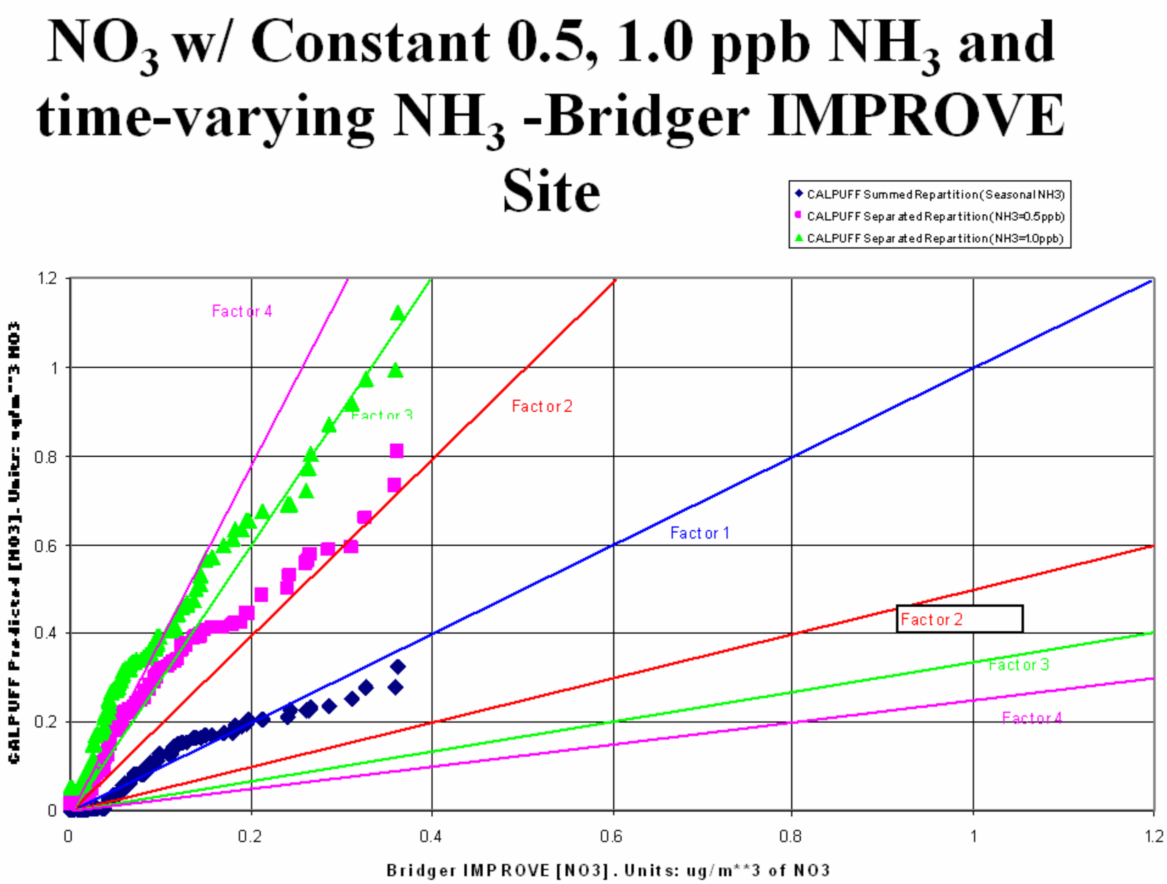
Discussion: We have had numerous discussions about this issue. At this time, it is not possible to change CALPUFF to enhance its treatment of aqueous-phase chemistry because the model developer, Earth Tech, is not currently prepared to take on that task. Joe Scire of Earth Tech also notes (2005) that an advanced algorithm for aqueous phase chemistry is highly dependent upon the concentration of hydrogen peroxide, which is not generally known. Therefore, it is not advisable to adopt a more advanced algorithm until scientists achieve a better understanding of hydrogen peroxide concentrations in the atmosphere. Any advanced treatment would directly access liquid water content input data, rather than the relative humidity surrogate values currently used.

As noted above, there is no appropriate “quick fix” to this treatment. The use of Eulerian regional models such as CAMx or CMAQ have other difficulties, such as lack of regulatory approval and insufficient validation; they could be challenged as unproven alternate models to CALPUFF and may suffer from the same dependence upon the unknown concentrations of hydrogen peroxide and other compounds. In addition, plume dispersion for individual sources is not adequately simulated in these models unless the meteorological resolution is very good (such as 4 km), which makes the effort involved too unwieldy.

To move on, we will run CALPUFF with its current algorithms for the proposed project and then provide for agency review a series of animation files of the concentration fields for further analysis for specific periods that the FLMs identify that are of interest.

The likely overprediction of nitrates in winter can be addressed by using a monthly variation of background ammonia concentrations. The default value of 1.0 ppb for arid lands as referenced in the IWAQM Phase 2 document is valid at 20 deg C, but the same document cites a strong dependence with ambient temperature, with variations of a factor of 3-4. This same dependence is seen at the CASTNET monitor at Bondville, Illinois (see page 5 at http://www.ladco.org/tech/monitoring/docs_gifs/NH3proposal-revised3.pdf). In addition, a study of light-affecting particles in SW Wyoming indicated that nitrates were overpredicted by a factor of 3 for a constant ammonia concentration of 1.0 ppb, and by a factor of 2 for an ammonia concentration of 0.5 ppb (see Figure 2-1, also provided as slide 57 at http://www.air.dnr.state.ga.us/airpermit/psd/dockets/longleaf/facilitydocs/050711_CALPUFF_eval.pdf). Since there are no large sources of ammonia due to agricultural activities near the Class I areas being analyzed, it is appropriate to introduce a monthly varying ammonia background concentration to the CALPUFF modeling. The following values are proposed (and have been agreed to by the National Park Service):

Figure 2-1 Prediction of NO_3 as a function of ammonia background concentration in SW Wyoming



- January- March: 0.2 ppb (average temperature ~ 20-40 deg F)
- April-May: 0.5 ppb (average temperature 40-50 deg F)
- June-September: 1.0 ppb (average temperature 60-70 deg F)
- October - November: 0.5 ppb (average temperature 40-50 deg F)
- December: 0.2 ppb (average temperature ~ 30 deg F).

Even the relative low wintertime estimate of 0.2 ppb could be too high for the coldest days that appear to trigger the most nitrate formation in the model, so additional sensitivity modeling may be presented for cold-weather months.

8. Since the FLAG method did not show low impacts for the proposed facility, a much more refined analysis must be undertaken to resolve the predicted project impacts.

Discussion: The FLAG method has several conservative features, most notably the inability to handle cases of peak visibility impact predictions when the natural visibility is limited due to nighttime conditions or obscuration due to precipitation and fog. Therefore, we conducted alternative analyses, which can show lower facility impacts. This was done for the May 2004 submittal. In this revised analysis, we will conduct a simpler alternative analysis along the lines of the BART approach. If such an approach shows low impacts (98% day with less than 0.5 deciview change), then we do not believe that a refined analysis is needed. The manner in which a refined analysis could be conducted is not defined, and has no precedent that the applicant is aware of.

9. The protocol we have discussed to date has really only dealt with the Desert Rock impacts in isolation. The issue of methods for a cumulative impact assessment is not covered. We expect that a cumulative assessment will still be done.

Discussion: We assume that this comment addresses the need for a cumulative impact assessment for regional haze. If so, it is first helpful to review two possible results from the modeling analysis for the proposed facility alone that determine whether a cumulative regional haze modeling analysis is needed.

One possible result is that the proposed project's impacts are shown <u>not</u> to cause a perceptible impact on regional haze in a Class I area. Although the application of a strict FLAG procedure once again may show impacts over a 5% extinction change from natural background, an alternative analysis may indicate no perceptible impact. Since FLAG arguably has many conservative assumptions, we will also look at the alternative analysis for concluding whether the proposed project's emissions are likely to cause a perceptible visibility impact. We will also provide a substantial amount of information to the National Park Service for their review as well. If the project shows an extinction change below 5% of natural background conditions, then a cumulative regional haze analysis is not needed.

Even if the proposed project could potentially have a perceptible visibility impact, it is clear from the language in a comment provided by the National Park Service that <u>*sulfate is a major constituent of regional haze in the Four Corners area*</u>. (Other components of lesser importance are NO_x and PM_{10} emissions.) The proposed facility will emit a maximum of about 3,300 tons per year of SO_2 and NO_x, and about 1,100 TPY of PM_{10}. As we noted in our presentation at the May 3, 2005 meeting in Fort Collins, the recently announced reductions of emissions from the nearby San Juan Generating Station are as follows by the year 2010, relative to emissions in 1999:

- SO_2 annual emissions reduced by nearly 7,000 TPY (vs. about 3,300 TPY Desert Rock)
- NO_x annual emissions reduced by about 7,000 TPY (vs. about 3,300 TPY Desert Rock)
- PM_{10} annual emissions reduced by nearly 2,500 TPY (vs. about 1,100 TPY Desert Rock)

In addition, recent changes in emissions at the nearby Four Corners Power Plant are also important to account for in the cumulative impact evaluation. These changes appear to be voluntary SO_2 emission reductions throughout 2004 due to increased scrubbing efficiency, and can be seen from data posted on the EPA's Acid Rain Database. Annual SO_2 emissions appear to be dropping from about 35,000 TPY to about 15,000 TPY, a reduction of some 20,000 TPY.

It is clear from the above tallies of emission reductions in the Four Corners area that a cumulative analysis, which should properly account for recent voluntary emission reductions, would clearly show that the reductions are many times the increases from the proposed project, especially for SO_2. Therefore, a cumulative regional haze analysis is clearly not necessary, because the cumulative impact will be an improvement even with the project's emissions included.

10. We want to be clear that the modeling protocol as currently presented will not satisfy two of our primary concerns. First, there is still no consideration of aqueous phase conversion of sulfates. Secondly, the meteorological fields proposed for use are still unlikely to capture some of the important flow phenomena that lead to impacts in the Class I areas in the region. We are attempting to generate more accurate wind fields for some specific time periods, and will make them available to you as soon as they are available.

We anticipate looking at these results as well as refining previous work done at the NPS when making our recommendations. We will need copies of all of the CALPUFF input and output files to complete our evaluations.

Discussion: As we have discussed extensively since the May 3 meeting, we attempted to engage the services of Joe Scire and Earth Tech to include enhancements to CALPUFF to address the concerns of the National Park Service. These attempts were unsuccessful. One reason for this is that the model developer does not feel that sufficient information about certain important compounds involved in SO_2 to sulfate transformation, such as hydrogen peroxide concentrations, is available to allow an enhanced algorithm to be practical. Basically, the unknowns associated with a more advanced algorithm make it unworkable at this time. Alternative modeling approaches might be SCICHEM for a Lagrangian model such as CALPUFF and Eulerian models such as CMAQ and CAMx; they may suffer from the same poor knowledge of certain critical compounds. None of these models have been used in a single-source PSD permitting application that we know of.

While advanced Eulerian models such as CAMx or CMAQ may better address the aqueous phase chemistry issue, the model dispersion is poorly characterized near the source and is dependent upon the grid size, as noted in the National Park Service's comments about REMSAD modeling that were provided prior to the May 3 meeting. Even if a 4-km grid size were to be developed for CAMx, the model running time might be as long as 2 weeks per simulation month, or about 50% of real time. Such a model run would be too resource-intensive for modeling a single source. In addition, a demonstration that the concentration predictions from CAMx and CMAQ are better than those of CALPUFF, which is required for use of an alternative model, is not available to our knowledge.

Therefore, we are proceeding with CALPUFF, but providing information on concentration patterns with animation files so that possible interactions of the plume with clouds can be further reviewed by the National Park Service. We will also provide concentration files so that, if warranted for a particular period, the National Park Service can add the SO_2 concentrations (multiplied by 1.5) to the SO_4 concentrations to simulate complete transformation to sulfate.

In terms of the adequacy of the meteorological data, we are using 3 years of the best available MM5 data, including the 12-km 2002 WRAP database. We are accommodating periods of 4-km MM5 as provided by the National Park Service that cover the periods identified as being of particular interest.

3.0 Procedures for final modeling of proposed project

3.1 Stack emission data

The facility layout has been revised since the May 2004 permit application, with the main stack location shifted within the plant boundaries. The new main stack location, within a meter, will be 719,690 UTM East and 4,041,760 UTM North, Zone 12, NAD 83. Exhaust characteristics of the stack have not changed. The stack emissions and the dependence of the exhaust parameters on ambient temperature are listed in Section 6.2.2 of the May 2004 PSD Permit Application document.

For purpose of regional haze modeling, the PM_{10} emissions are further speciated as specified by Sithe Global:

- Half of the emissions are assumed to be filterable, and half condensable (0.010 lb/MMBtu for each portion).
- The particle size distributions are based on the EPA's *Compilation of Air Pollutant Emission Factors, Publication AP-42,* Tables 1.1-5 (for a baghouse control technology) and 1.1-6. The size ranges considered are based on AP-42 Table 1.1-6, which provides size ranges for filterable PM. Table 1.1-5 of AP-42 indicates that condensable PM can be assumed to be < 1.0 micron in diameter. Therefore, the non-sulfate condensable emissions will be assigned to the smallest size category. Sulfate emissions are modeled separately as primary SO_4^-.
- Of the total filterable PM_{10} emissions, 96.3% of "fine" particulate emissions are considered "soils", and 3.7% elemental carbon (following guidance in AP-42 Table 1.1-5); all of the "coarse" particles are assumed as "soils". The elemental carbon is provided a size distribution throughout the fine particle categories in the proportion assigned to the four size categories in the sub-2.5 micron range. The condensable PM emissions will be considered to be composed of H_2SO_4 and secondary organic aerosols, all in the smallest size category.

The Class I analysis modeling will consider only the main stack only at 100 percent load. A SCREEN3 analysis, provided in Appendix D of the modeling protocol submitted in May 2004 indicates that the lowest normal operating load case (40% of capacity) can possibly lead to the highest near-field concentration predictions. Therefore, for the Class II analysis, the main stack at both 40 and 100 percent (maximum and minimum) load for both one and two units operating will be modeled (stack parameters for these cases have not changed from the May 2004 submittal). Emissions from the auxiliary boiler, the diesel generator and fire water pump, and the material-handling sources will also included in the Class II compliance analysis.

3.2 PSD Class II modeling procedures

A local modeling domain that extends approximately 125 km in the east-west direction and 190 km in the north-south direction from the proposed facility location is proposed for this near-field Class II CALPUFF modeling analysis (and the Class I analysis for Mesa Verde), as shown in Figure 3-1. The grid spacing for this analysis is 500 m.

For the Class II modeling within 50 km, plant emissions from the main stack as well as low-level combustion and fugitive sources will be included. The plant impacts will be compared with Significant Impact Levels to determine the need for cumulative modeling. Based upon previous results, cumulative modeling is likely to be required for SO_2 and PM_{10}. In a cumulative modeling assessment, the project sources, along with secondary sources (such as the BHP mine emissions) and other nearby sources will be modeled with CALPUFF to demonstrate compliance with PSD Class II increments and the NAAQS.

3.3 PSD Class I modeling procedures

For the Class I modeling (and for distant sensitive Class II areas that were previously modeled), CALPUFF will be used as described in Section 2 for the main stack emissions as described in Section 3.1. The project is likely to have a modeled significant impact for SO_2, but not for PM_{10} and NO_2. Therefore, we have had extensive discussions with EPA Region 9 regarding the sources and emission rates for the cumulative analysis for SO_2. More details regarding this inventory are provided in Appendix A.

The regional haze modeling will be conducted using the FLAG approach (with an RHMAX = 95% and EPA f(RH) curves), and alternative analyses will consider the following features:

- Using the BART approach with Method 6 and reporting the 98 percentile day (8th highest for each year, and 22nd highest over 3 years) to determine whether the project has an impact over 0.5 deciviews (about 5% change in extinction)
- Use of a finer grid resolution for areas such as Mesa Verde, for which a grid spacing as small as 0.5 km may be run, as described above. The purpose of this exercise would be to better define the terrain features within the modeling domain, especially at the nearest Class I area.
- Use of an alternative dispersion option (similar to the AERMOD treatment) may be considered for the project emission impact because this method is consistent with EPA's recent updates for short-range model, for which ISCST3 has been replaced by AERMOD.

Files showing the isopleths of gridded concentration data will be provided for review by the FLMs. If feasible, liquid water content fields associated with the MM5 data will also be displayed.

The CALPUFF modeling will be conducted for all aspects of the analysis (PSD increment consumption, regional haze, and acidic deposition) for the period 2001-2003. The National Park Service has provided 4-km and 12-km MM5 data for the following periods (involving complete days of data):

- 2001: January 3 – January 29
- 2003: January 1 – January 16
- 2004: April 20 – May 1.

These periods will be run only for the assessment of regional haze impacts because they were provided to us due to specific concerns for that Air Quality Related Value (AQRV). Results for these periods will be directly compared to the same periods with the full year MM5 data for 2001 and 2003.

For these selected periods, 4-km MM5 data is not available at all PSD Class I areas within 300 km of the proposed project site. However the 12-km MM5 data does cover all of the Class I areas within 300 km of the project site. Therefore, the selected periods mentioned above will be run with 4-km MM5 data for:

- Canyonlands
- Capitol Reef
- Grand Canyon
- Mesa Verde
- Weminuche.

Portions of these Class I areas that are either very close to the edge or outside of the 4-km MM5 data set or are greater than 300 km from the proposed source will not be assessed with this grid. The 4-km MM5 runs will be conducted with a 3-km CALMET grid resolution (except for Mesa Verde) and the domain depicted in Figure 3-1.

The remaining Class I areas will be assessed using the 12-km MM5 for the same periods of interest. Those areas are as follows:

- Arches
- Black Canyon of the Gunnison
- Bandelier
- Great Sand Dunes
- La Garita
- Pecos
- Petrified Forest
- San Pedro Park
- West Elk
- Wheeler Peak

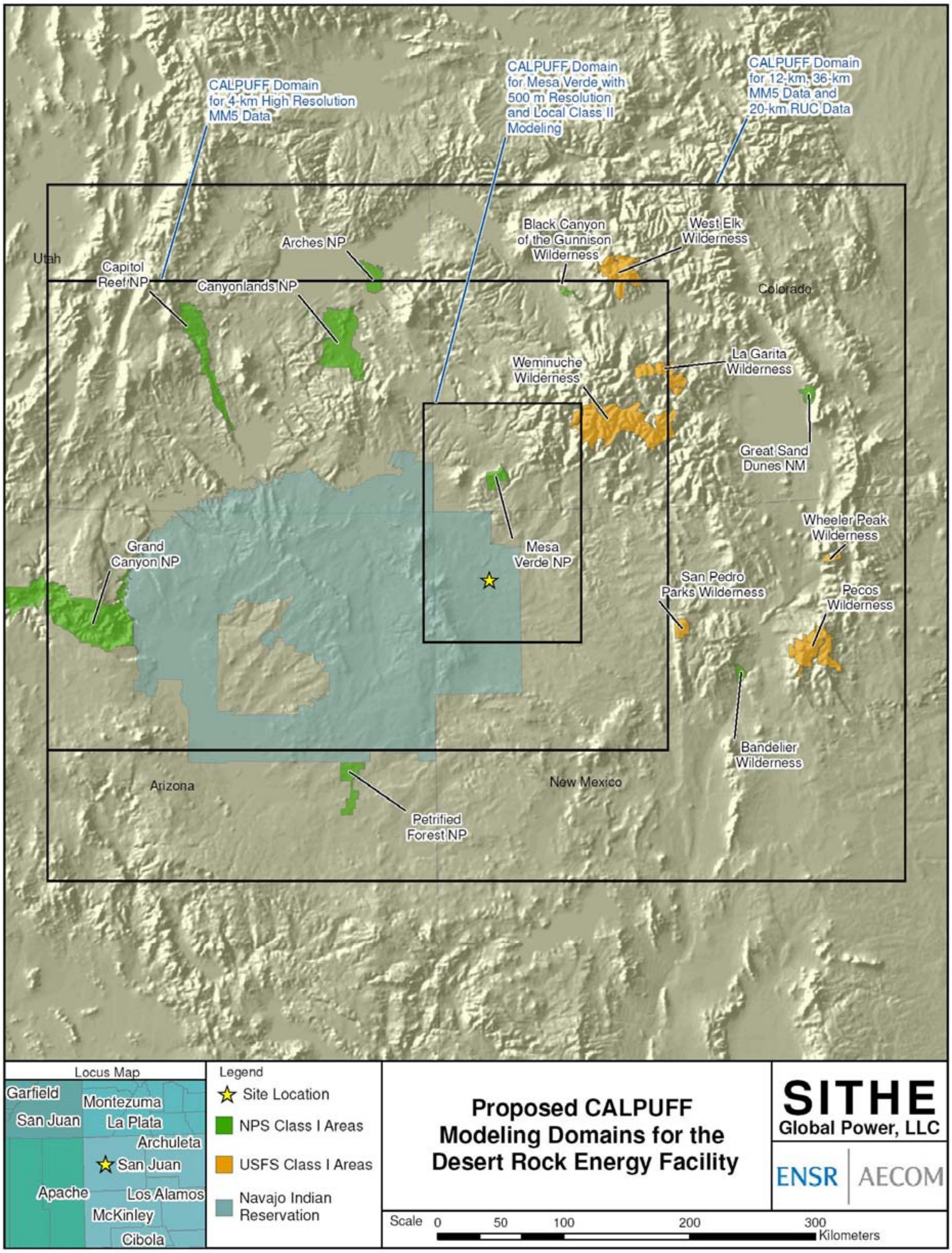
The 12-km MM5 runs will be conducted with 4-km CALMET grid resolution and the original domain designed for this project as depicted in Figure 3-1.

The following technical options and settings have been agreed upon by EPA Region 9, the NPS, and ENSR.

- The monthly background ammonia values listed in Section 2 will be used.
- Puff splitting will not be activated. Sensitivity runs with this option produced small changes in the modeling results, but with large effects upon model runtime.
- MDISP = 3 (P-G dispersion coefficients) will be used for the CALPUFF modeling. In some sensitive areas such as regional haze impacts of the proposed project or SO_2 increment consumption analyses, an alternative modeling assessment using MDISP=2 and MPDF=1 may be provided.
- For certain CALMET settings, the following guidance applies:
  - 4-km MM5 (for certain Class I Areas from periods in 2001, 2003, and 2004):
    - TERRAD = 10 km
    - R1 = 2 km
    - R2 = 20 km
    - RMAX1 = 6 km
    - RMAX2 = 30 km

  - 12-km MM5 (all of 2002 and for certain Class I Areas from periods in 2001, 2003, and 2004):
    - TERRAD = 10 km
    - R1 = 6 km
    - R2 = 20 km
    - RMAX1 = 12 km
    - RMAX2 = 30 km

Figure 3-1 Depiction of CALMET/CALPUFF modeling domains



- 20-km RUC (all of 2003):
    - TERRAD = 10 km
    - R1 = 10 km
    - R2 = 20 km
    - RMAX1 = 20 km
    - RMAX2 = 30 km

- 36-km MM5 (all of 2001):
    - TERRAD = 10 km
    - R1 =18 km
    - R2 = 20 km
    - RMAX1 = 30 km
    - RMAX2 = 100 km

ENSR has already provided meteorological evaluations of the MM5 data used in the May 2004 submittal. Of these MM5 data sets, the 2001 and 2002 data sets are being replaced by publicly available data used in several regional modeling exercises. Reports describing the meteorological evaluations for the 2001 and 2002 MM5 databases are available (McNally, 2003 and ENVIRON and UC Riverside, 2004). Independent evaluations of the 4-km MM5 databases supplied directly from the National Park Service will not be conducted.

The National Park Service may conduct their own analysis of possible periods for which significant aqueous phase chemistry transformation of SO_2 to sulfates should be predicted to occur.

4.0 References

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Scire, J.S., F.R. Robe, M.E. Fernau, and R.J. Yamartino, 2000b: A User's Guide for the CALMET Meteorological Model (Version 5). Earth Tech, Inc., Concord, MA.

Appendix A

Cumulative SO_2 PSD Inventory

Appendix A: Cumulative SO_2 PSD inventory

Key issues with regard to the appropriate entries in the cumulative SO_2 PSD increment inventory for this project are:

1. What is the appropriate emission rate that reflects "maximum actual" emissions, especially if facility-wide emissions could reflect periods with some units lower than peak production or even off-line?

Discussion: EPA Region 9 talked to other EPA regions on this question. There seems to be agreement that one should use the maximum actual hourly rate, though some regions felt there was some justification for using, e.g., 90th percentile as indicative of "normal" source operation, as opposed to the 100th percentile, which would include anomalous spikes, as it does for at least some of the Four Corners Power Plant (FCPP) units. In Region 8's own modeling for North Dakota SO_2 increment, 90th percentile was used because it is very unlikely that all sources would simultaneously operate at their maximum; and further, the sum of the 90th percentiles was close to the maximum emissions that actually occurred. In this case, the sources are not as clustered as they are for the North Dakota situation, so a percentile value closer to 100% would be conservative. Due to the fact that the 100th percentile case does include hours that involve upset conditions, and because the shortest regulatory averaging time is 3 hours for SO_2, a 99th percentile selection based upon hourly values for emitting unit should be quite conservative. For more conservatism, the 99th percentile is taken only from the nonzero emission hours for each EGU unit for years 2003 and 2004, and averaged to provide the emission value for input to the model.

2. For the Four Corners Power Plant and the San Juan Generating Station, what are the appropriate baseline emissions that reflect the same "maximum actual" treatment as current emissions?

Discussion: There were Federal Register notices in 1981 that addressed appropriate emission limits for the FCPP and San Juan Generating Station (SJGS) units. Language from 46 FR 30653-30654, June 10, 1981 states: "The revised emission limits provide for an average of 60 percent control for Four Corners units 1, 2 and 3 and no control on units 4 and 5 by the end of 1982, and an average of 72 percent control for the entire Four Corners plant (5 units total) by the end of 1984." "Plant-wide average SO_2 emissions will be 0.47 lb/MMBtu for The Four Corners plant and 0.65 lb/MMBtu for the San Juan plant after 1984."

In summary, for FCPP, the 1981 SO_2 limit requirement for 1984 is 0.47 lb/MMBtu for FCPP; 72% control. For SJGS, the 1981 limit requirement for 1984 is 0.65 lb/MMBtu. These values are long-term averages. To obtain maximum short-term peaks for the baseline period, a ratio of peak to mean will be established for each relevant unit at FCPP and SJGS for 2003 and 2004, and then applied to this mean baseline emissions given above to represent the peak short-term baseline emissions for each unit.

The resulting SO_2 PSD increment inventory is provided in Table A-1. The modeling archive will include spreadsheets that support the values provided in the table.

Table A-1 SO_2 PSD increment inventory

Facility Name	Lat (deg)	Long (deg)	Base El. (m)	2003-2004 99%tile Emissions (g/s)	Stack Height (m)	Stack Temp (K)	Exit Velocity (m/s)	Stack Diameter (m)
PSD Increment Consuming Sources								
Desert Rock	36.50	-108.55	1645.8	102.810	279.50	323.15	24.99	11.21
Cholla Unit 2	34.93	-110.30	1529.0	89.089	167.64	348.71	34.14	4.48
Springerville GS	34.32	-109.17	2128.0	1064.432	152.40	339.00	21.30	6.10
Abitibi Consolidated	34.50	-110.33	1844.0	43.650	65.23	380.37	18.35	3.66
AE Staley MFG	37.58	-106.09	2322.6	2.451	5.18	1273.00	20.80	0.10
Nixon Unit 1	38.63	-104.71	1676.4	220.322	140.21	422.59	19.62	5.33
Kinder Morgan	37.47	-108.79	2017.8	1.008	6.10	644.26	2.54	0.61
Cameo Station (current)	39.15	-108.32	1463.0	82.566	45.72	399.81	7.77	2.67
Nucla Station	38.24	-108.51	1694.7	69.466	65.53	408.15	23.34	3.66
Holcim-Florence	38.38	-105.02	1536.2	109.000	110.00	376.00	14.52	6.00
Holcim-Florence	38.38	-105.02	1536.2	44.900	110.00	356.00	13.99	1.70
Hunter Unit 2	39.17	-111.03	1723.6	103.210	182.88	329.26	17.82	7.32
Hunter Unit 3	39.17	-111.03	1723.6	92.767	182.88	322.04	16.63	7.32
Lisbon Flare	38.16	-109.28	1828.8	1.155	12.20	613.15	83.58	0.46
Lisbon Incinerator	38.16	-109.27	1828.8	38.800	64.98	736.76	7.35	1.83
Consolidated Constr.	36.71	-108.24	1638.3	4.299	12.80	427.59	19.60	1.036
San Juan GS Unit 3	36.80	-108.44	1614.9	264.835	121.92	322.04	15.85	8.534
San Juan GS Unit 4	36.80	-108.44	1614.9	299.264	121.92	322.04	15.85	8.534
Bloomfield Refinery	36.70	-107.97	1673.3	5.383	24.38	1273.15	20.12	0.305
Peabody Mustang	35.66	-107.91	2112.3	43.474	147.28	343.09	18.29	5.505
Tri-State Escalante	35.41	-108.08	2103.8	47.110	138.07	324.26	15.24	6.096
PSD Increment Expanding Sources*								
Cameo Station (baseline)	39.15	-108.32	1463.0	-79.254	12.65	416.5	2.29	45.72
San Juan Unit 1	36.80	-108.44	1614.9	-373.839	121.92	317.59	18.29	6.096
San Juan Unit 2	36.80	-108.44	1614.9	-348.371	121.92	317.59	18.29	6.096
Four Corners Unit 1	36.69	-108.48	1615.0	-79.627	76.20	327.59	18.29	5.36
Four Corners Unit 2	36.69	-108.48	1615.0	-67.202	76.20	327.59	18.29	5.36
Four Corners Unit 3	36.69	-108.48	1615.0	-62.855	76.20	327.59	31.63	4.36
Four Corners Unit 4	36.69	-108.48	1615.0	-162.148	115.82	333.15	23.89	8.69
Four Corners Unit 5	36.69	-108.48	1615.0	-109.897	115.82	333.15	18.29	8.69
*Baseline peak emissions listed								

U.S. Locations

AK, Anchorage
(907) 561-5700

AK, Fairbanks
(907) 452-5700

AL, Birmingham
(205) 980-0054

AL, Florence
(256) 767-1210

CA, Alameda
(510) 748-6700

CA, Camarillo
(805) 388-3775

CA, Orange
(714) 973-9740

CA, Sacramento
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CO, Ft. Collins
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Ft. Collins Tox Lab
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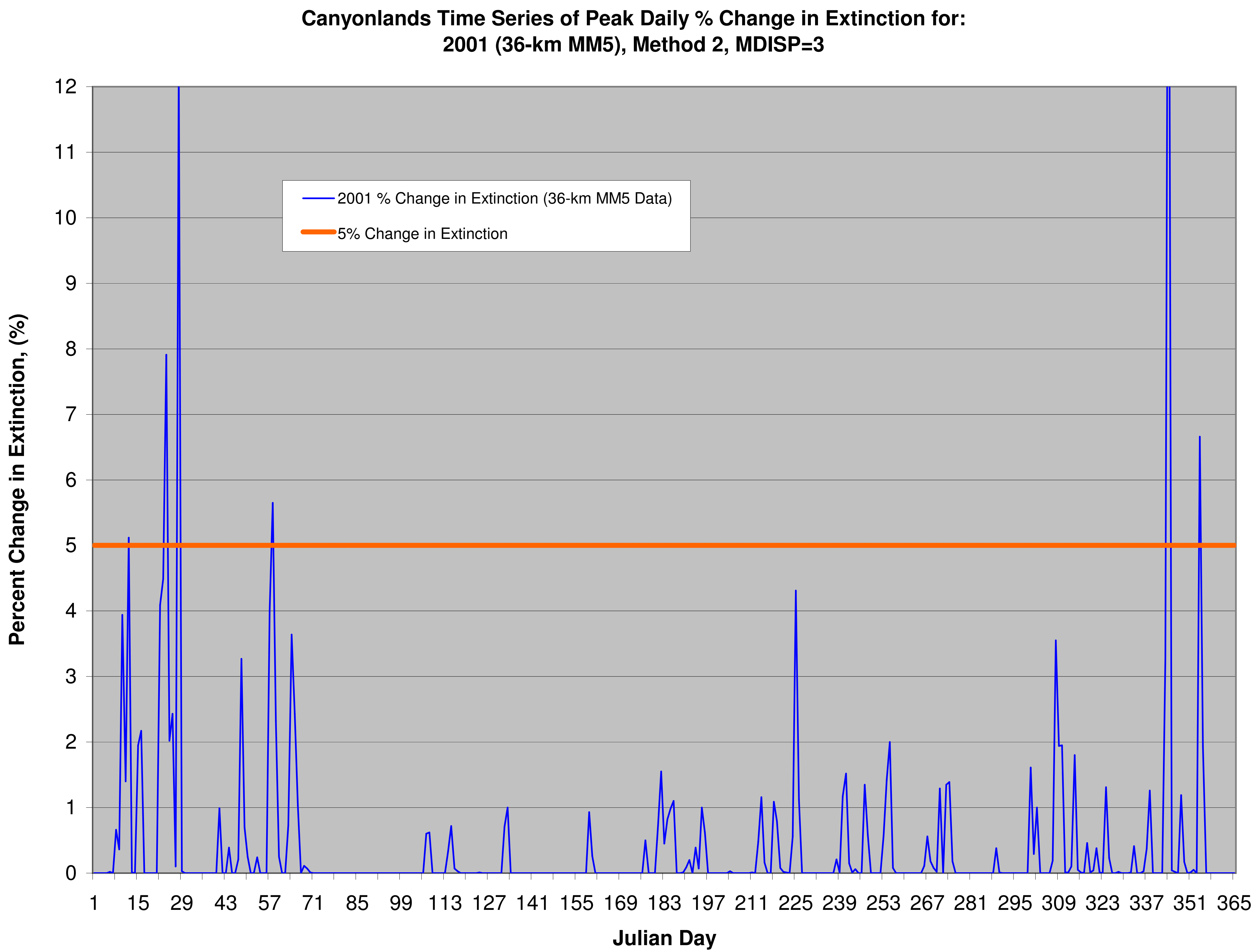
Appendix B

Time Series Plots of Daily Maximum Extinction Change at Selected Class I Areas


Canyonlands Time Series of Peak Daily % Change in Extinction for:
2001 (36-km MM5), Method 2, MDISP=3
2001 % Change in Extinction (36-km MM5 Data)
5% Change in Extinction
Percent Change in Extinction, (%)
Julian Day
0
1
2
3
4
5
6
7
8
9
10
11
12
1
15
29
43
57
71
85
99
113
127
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155
169
183
197
211
225
239
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267
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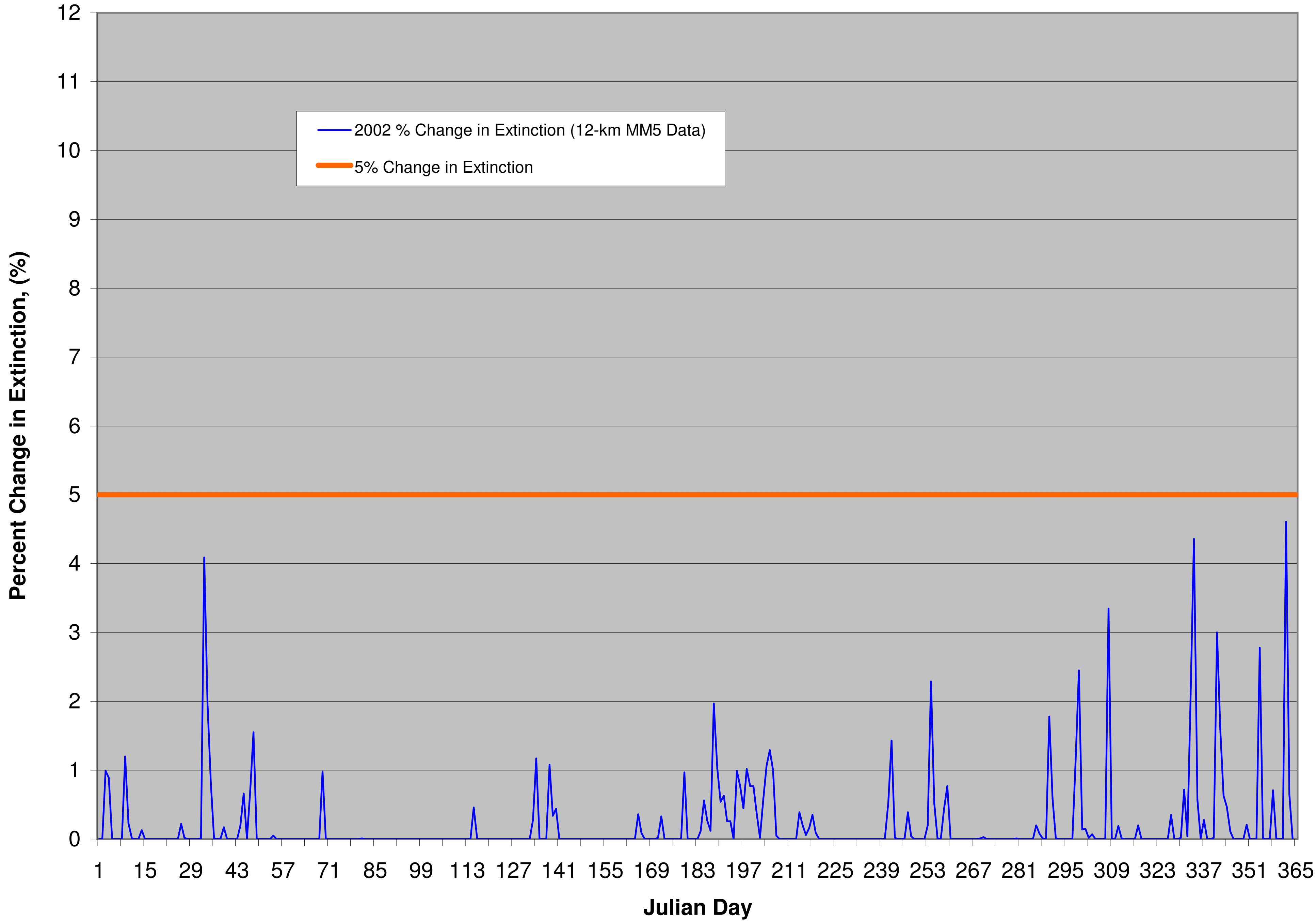
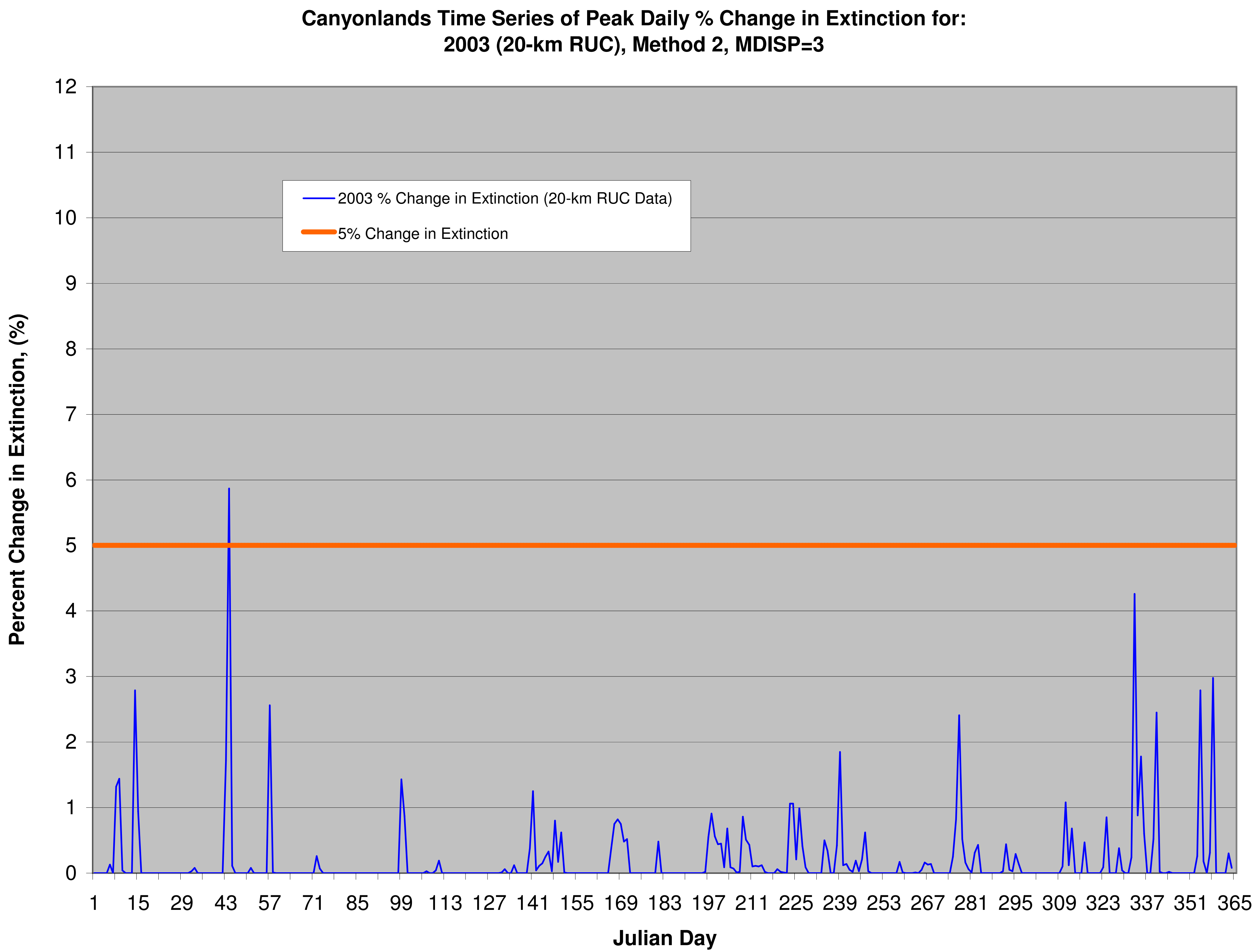
351
365

Canyonlands Time Series of Peak Daily % Change in Extinction for: 2002 (12-km MM5), Method 2, MDISP=3




Canyonlands Time Series of Peak Daily % Change in Extinction for:
2003 (20-km RUC), Method 2, MDISP=3
2003 % Change in Extinction (20-km RUC Data)
5% Change in Extinction
Percent Change in Extinction, (%)
Julian Day
0
1
2
3
4
5
6
7
8
9
10
11
12
1
15
29
43
57
71
85
99
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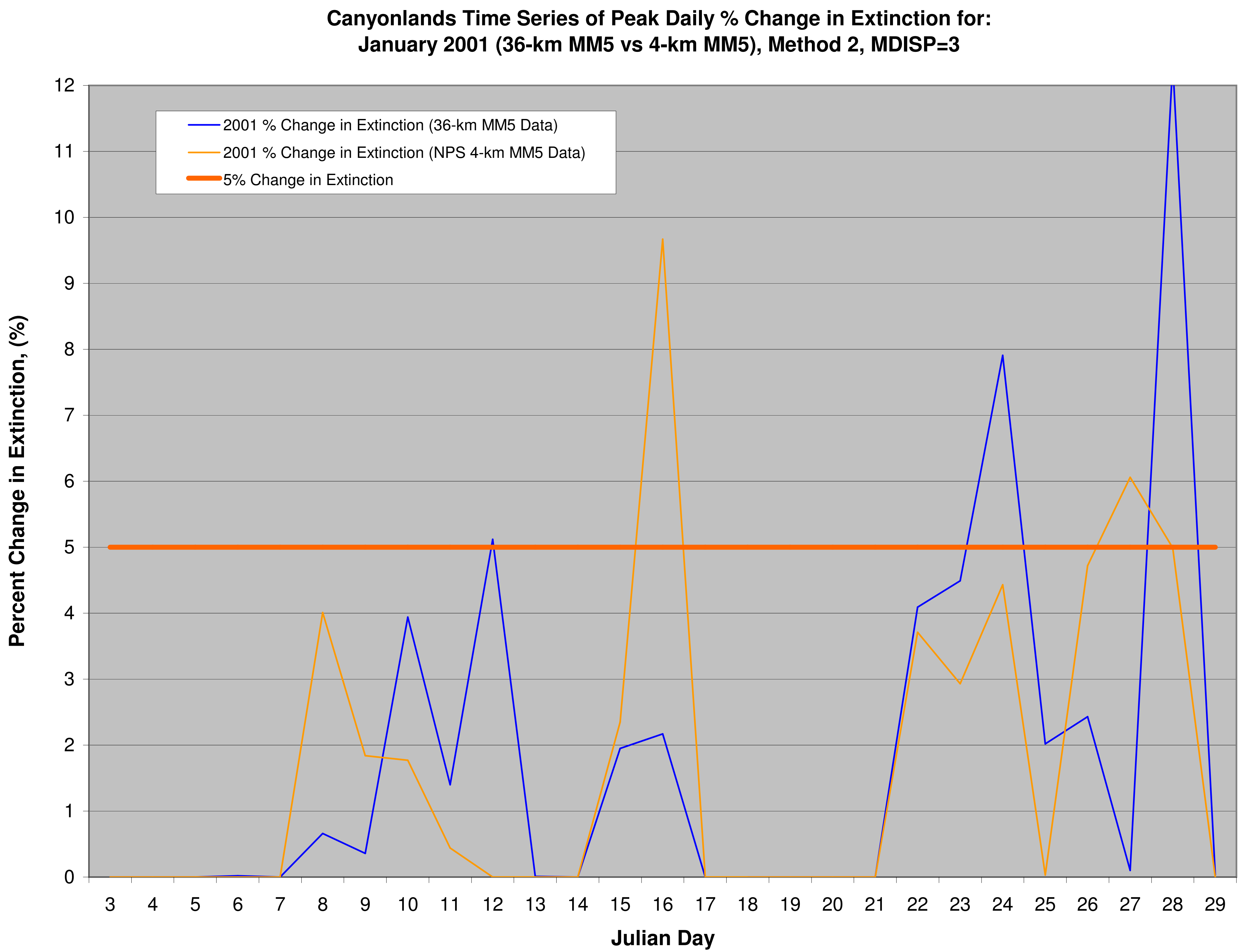
365


Canyonlands Time Series of Peak Daily % Change in Extinction for:
January 2001 (36-km MM5 vs 4-km MM5), Method 2, MDISP=3
2001 % Change in Extinction (36-km MM5 Data)
2001 % Change in Extinction (NPS 4-km MM5 Data)
5% Change in Extinction
Percent Change in Extinction, (%)
0
1
2
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7
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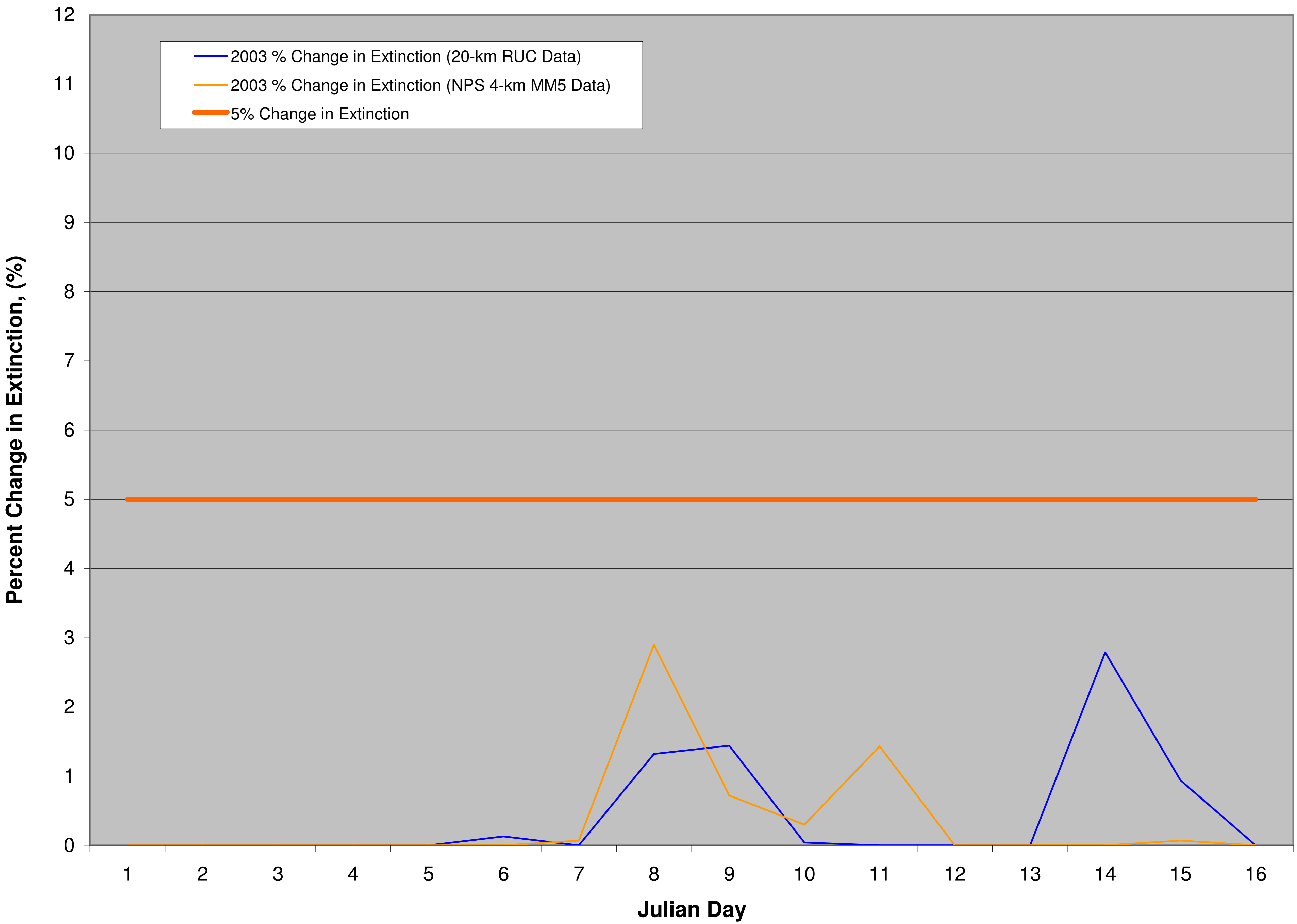
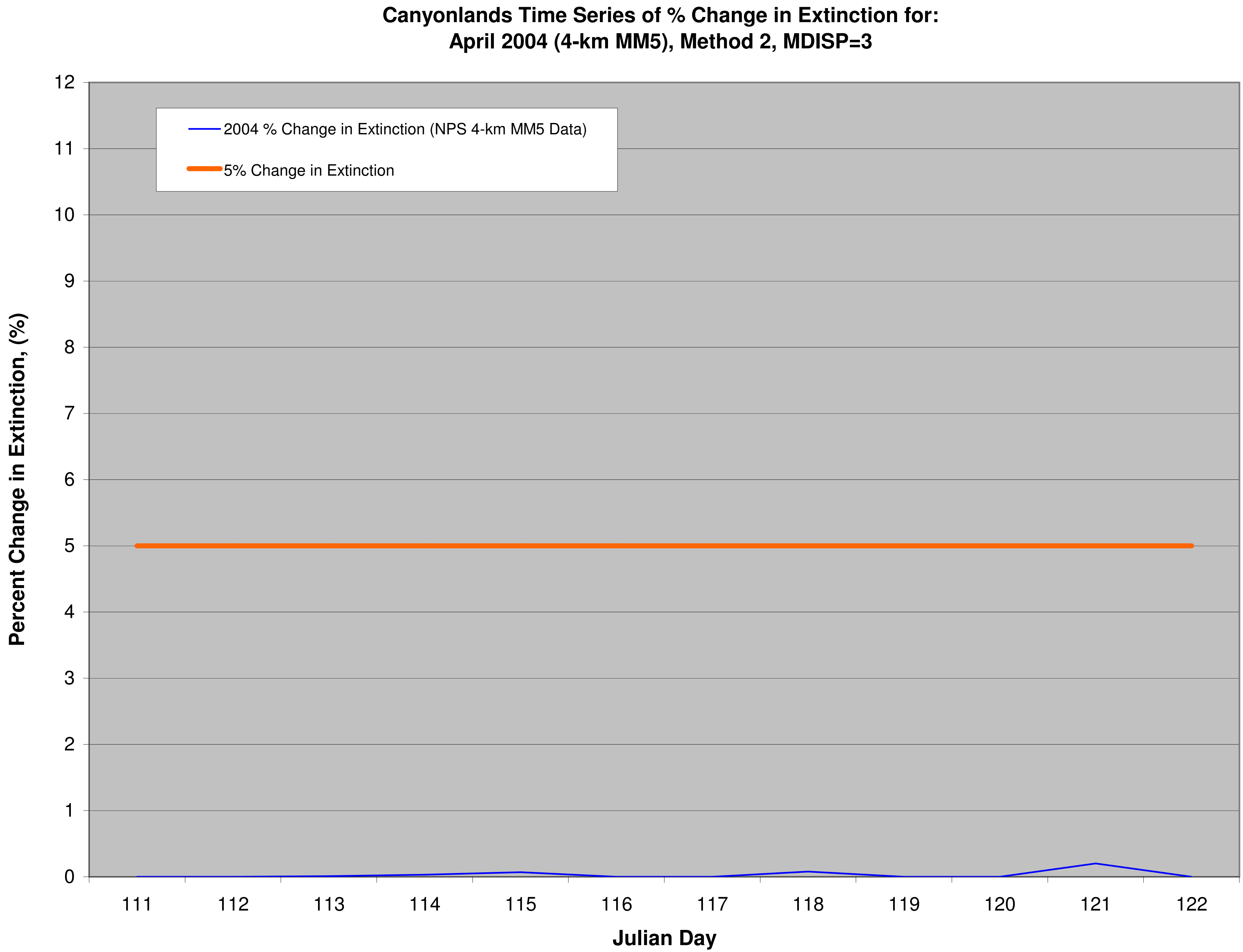
Julian Day

Canyonlands Time Series of Peak Daily % Change in Extinction for: January 2003 (20-km RUC vs 4-km MM5), Method 2, MDISP=3





Canyonlands Time Series of % Change in Extinction for:
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2004 % Change in Extinction (NPS 4-km MM5 Data)
5% Change in Extinction
Percent Change in Extinction, (%)
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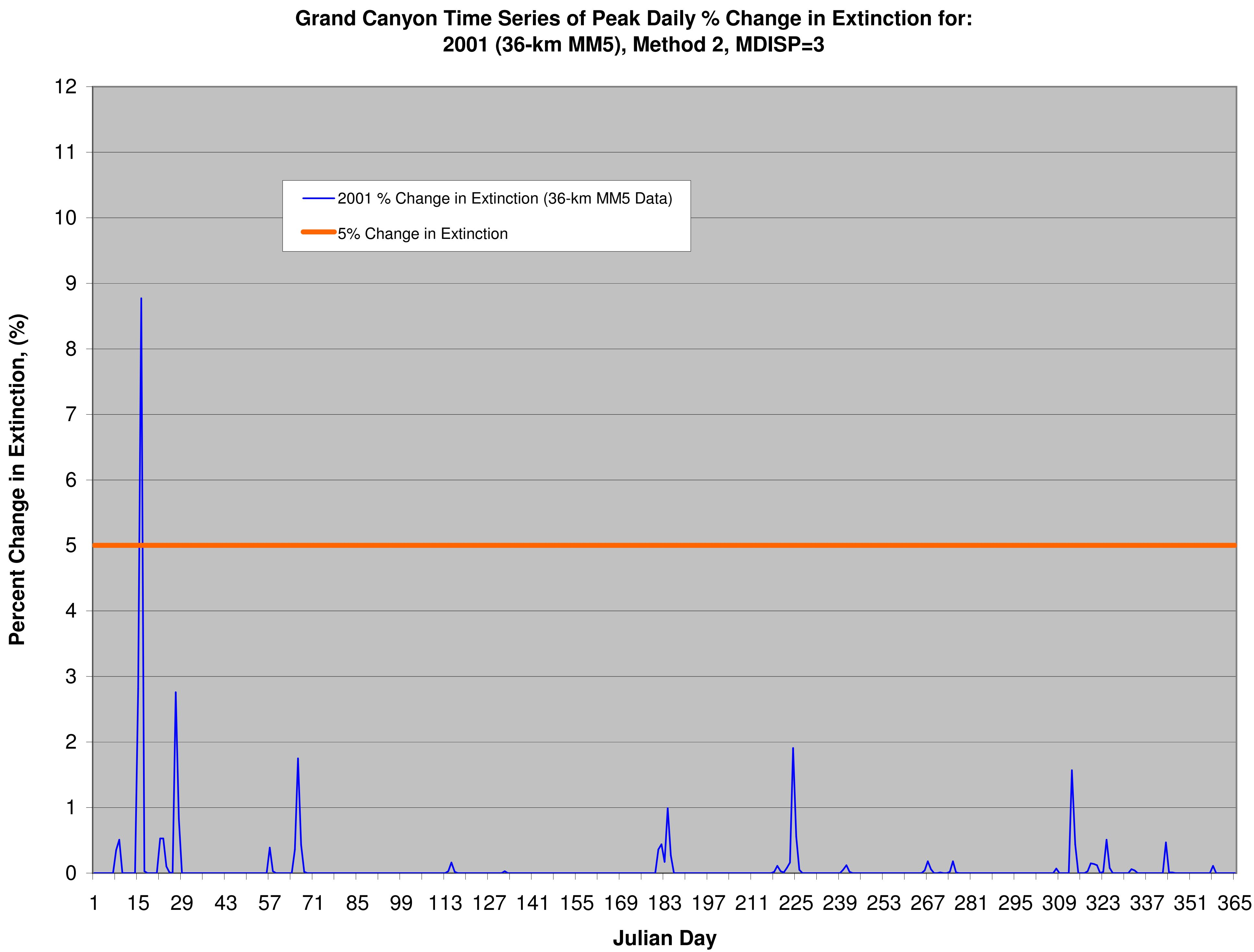
Grand Canyon Time Series of Peak Daily % Change in Extinction for:
2001 (36-km MM5), Method 2, MDISP=3
2001 % Change in Extinction (36-km MM5 Data)
5% Change in Extinction
Percent Change in Extinction, (%)
Julian Day
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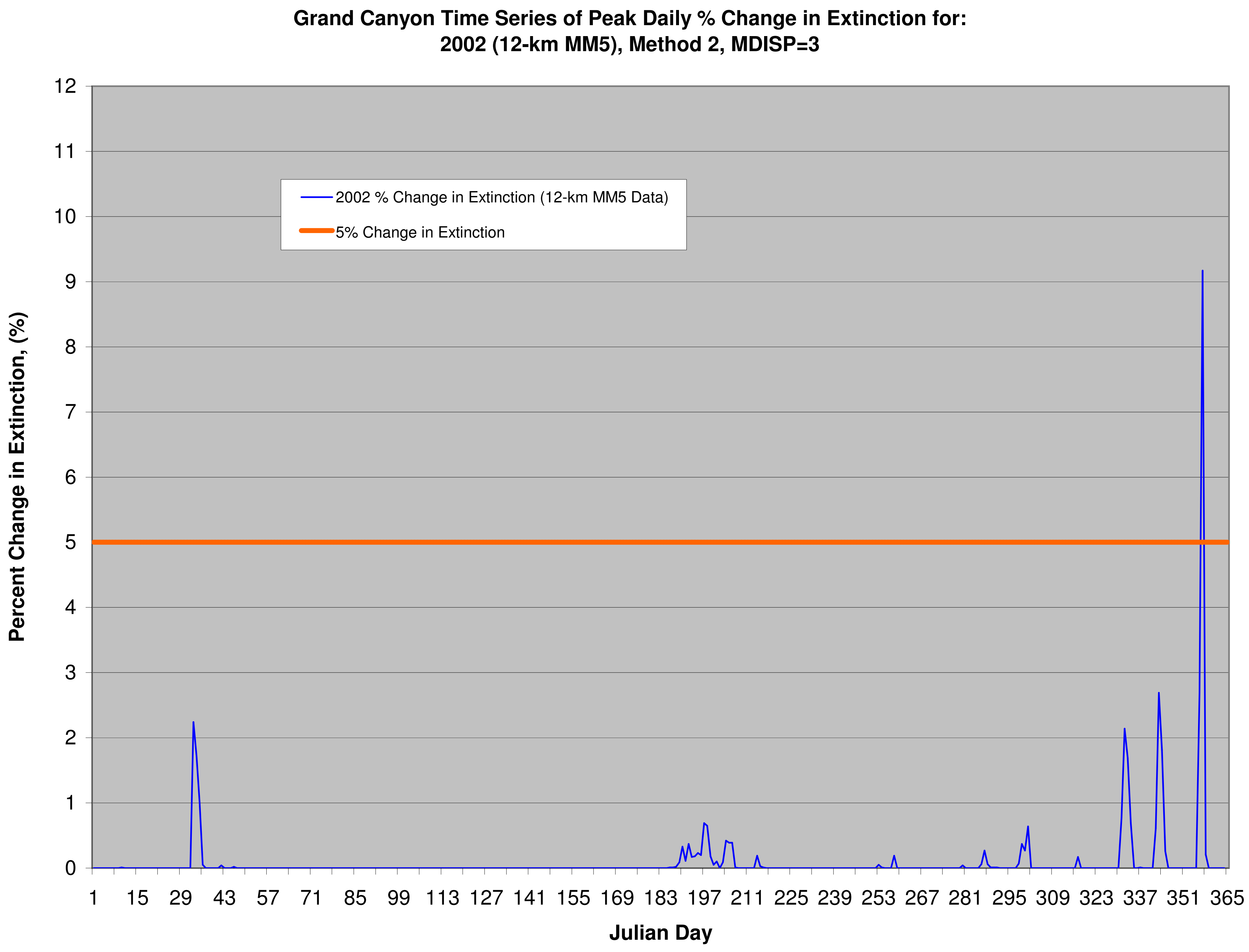
Grand Canyon Time Series of Peak Daily % Change in Extinction for:
2002 (12-km MM5), Method 2, MDISP=3
2002 % Change in Extinction (12-km MM5 Data)
5% Change in Extinction
Percent Change in Extinction, (%)
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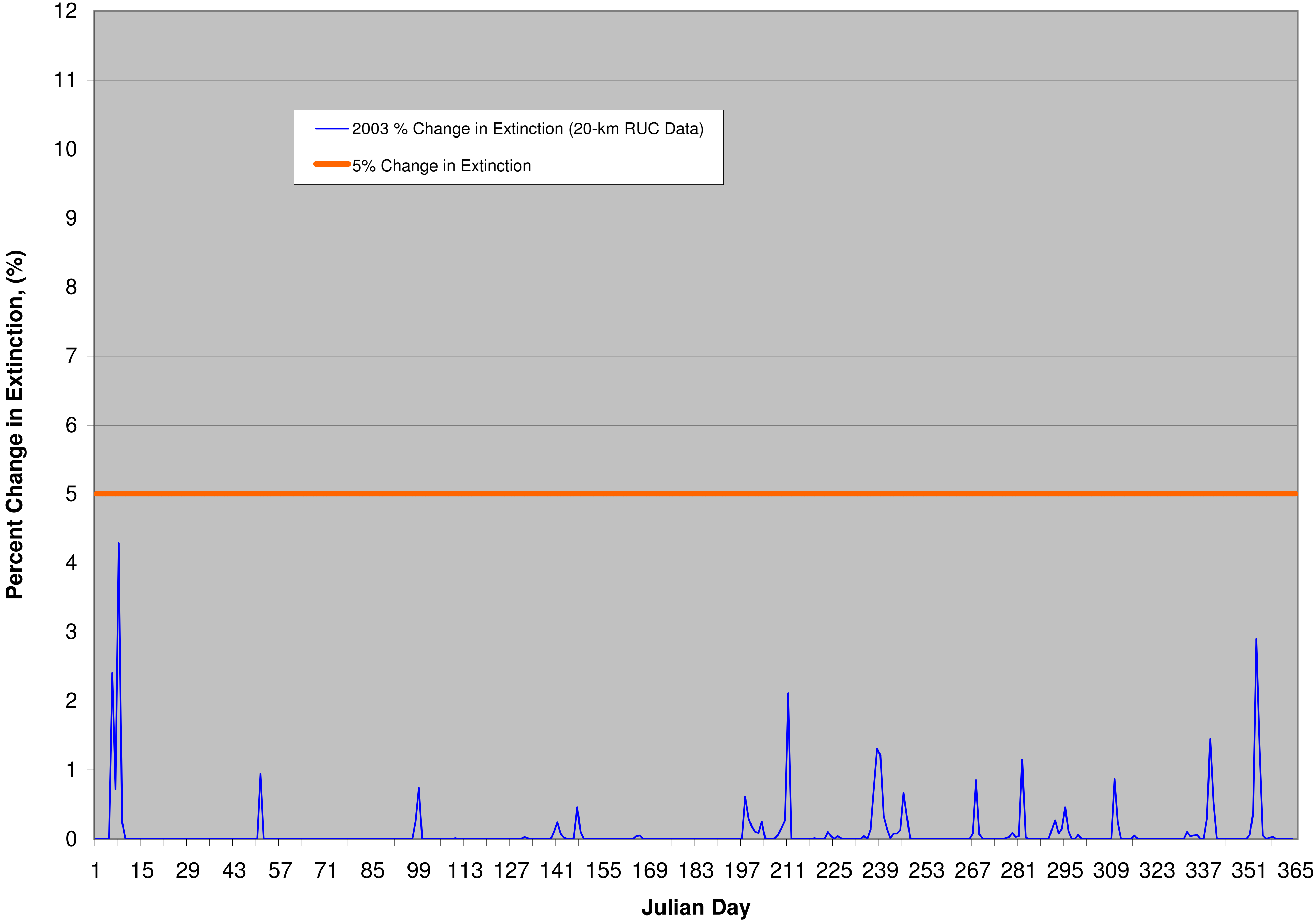
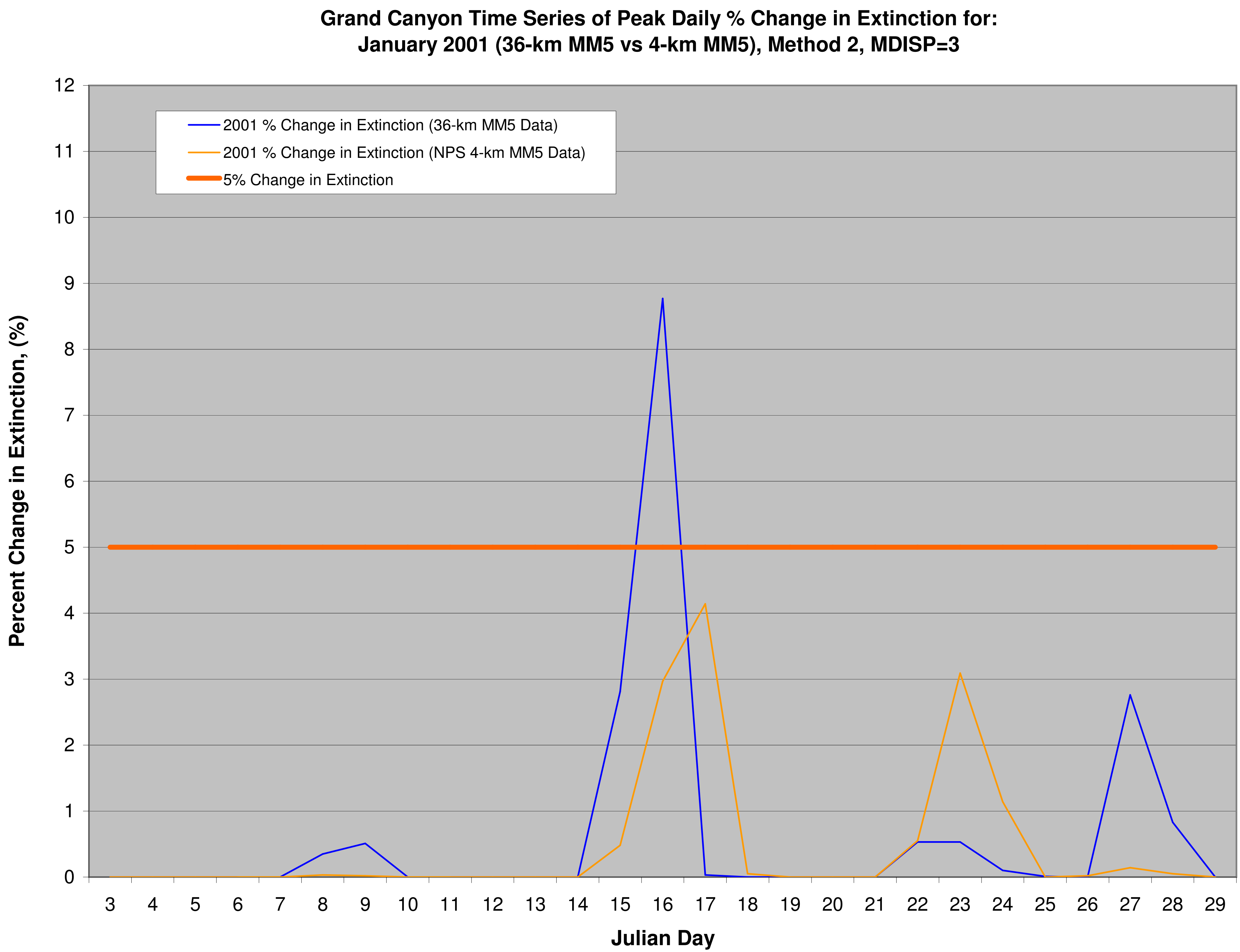
Grand Canyon Time Series of Peak Daily % Change in Extinction for: 2003 (20-km RUC), Method 2, MDISP=3




Grand Canyon Time Series of Peak Daily % Change in Extinction for:
January 2001 (36-km MM5 vs 4-km MM5), Method 2, MDISP=3
2001 % Change in Extinction (36-km MM5 Data)
2001 % Change in Extinction (NPS 4-km MM5 Data)
5% Change in Extinction
Percent Change in Extinction, (%)
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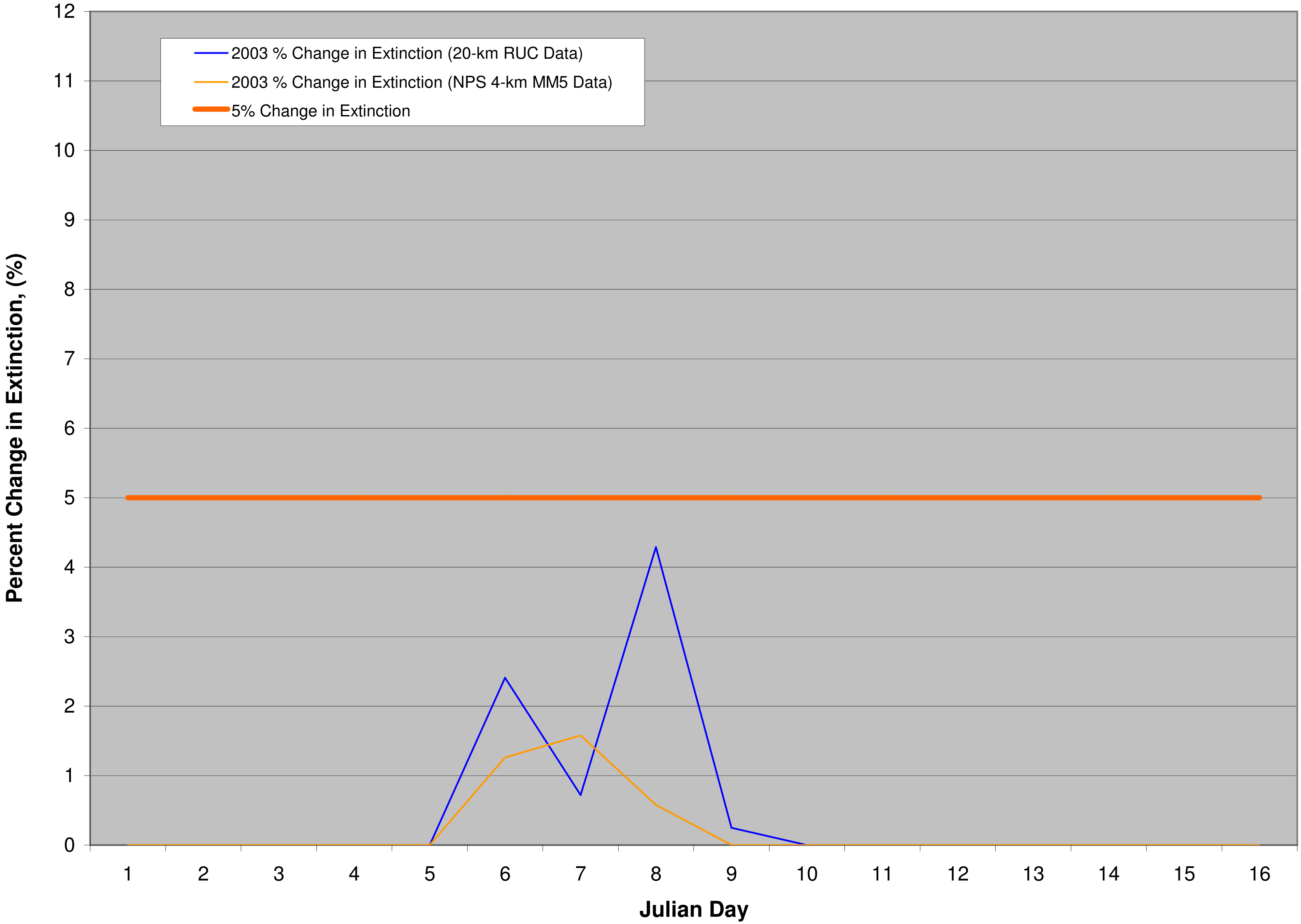
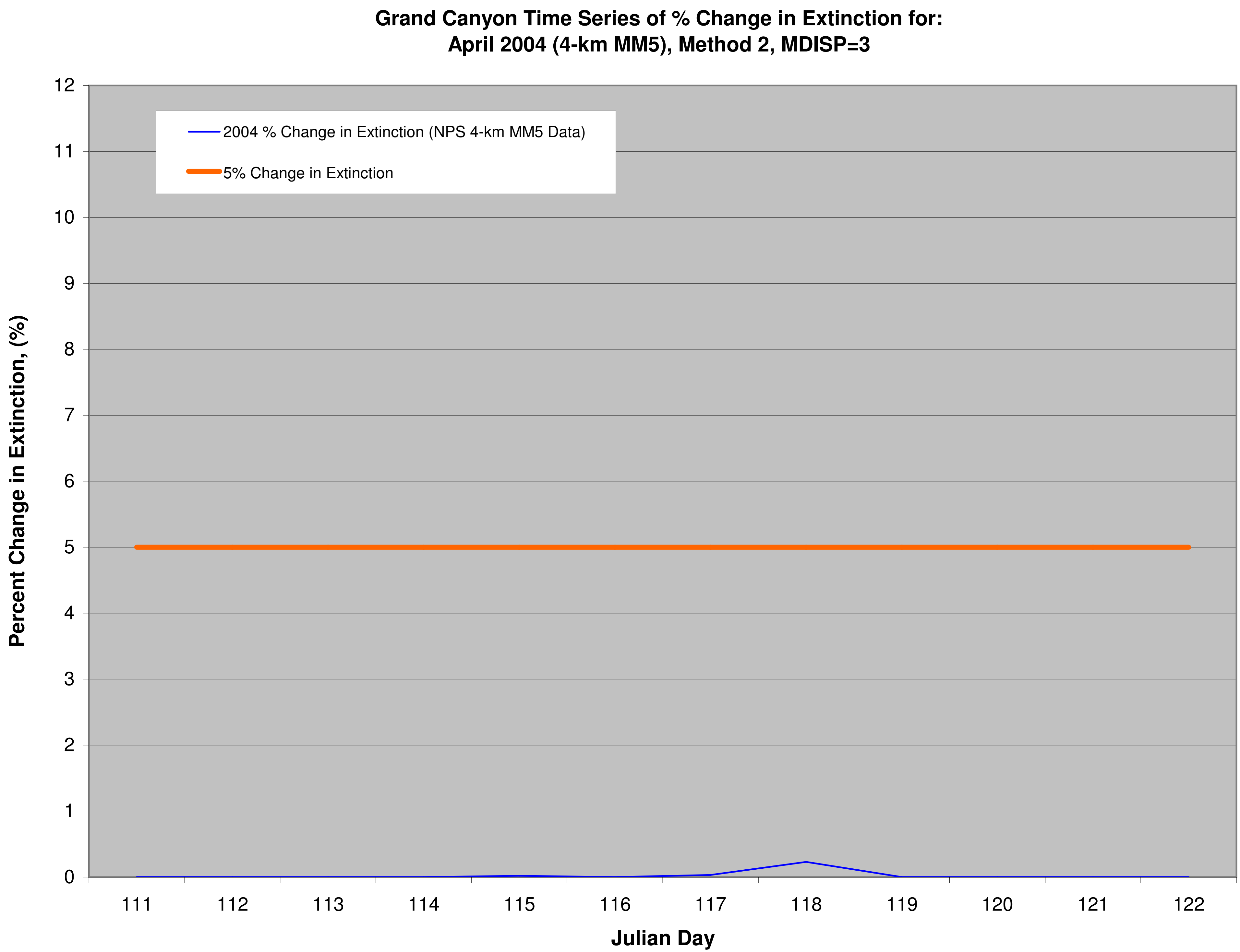
Julian Day

Grand Canyon Time Series of Peak Daily % Change in Extinction for:
January 2003 (20-km RUC vs 4-km MM5), Method 2, MDISP=3





Grand Canyon Time Series of % Change in Extinction for:
April 2004 (4-km MM5), Method 2, MDISP=3
2004 % Change in Extinction (NPS 4-km MM5 Data)
5% Change in Extinction
Percent Change in Extinction, (%)
Julian Day
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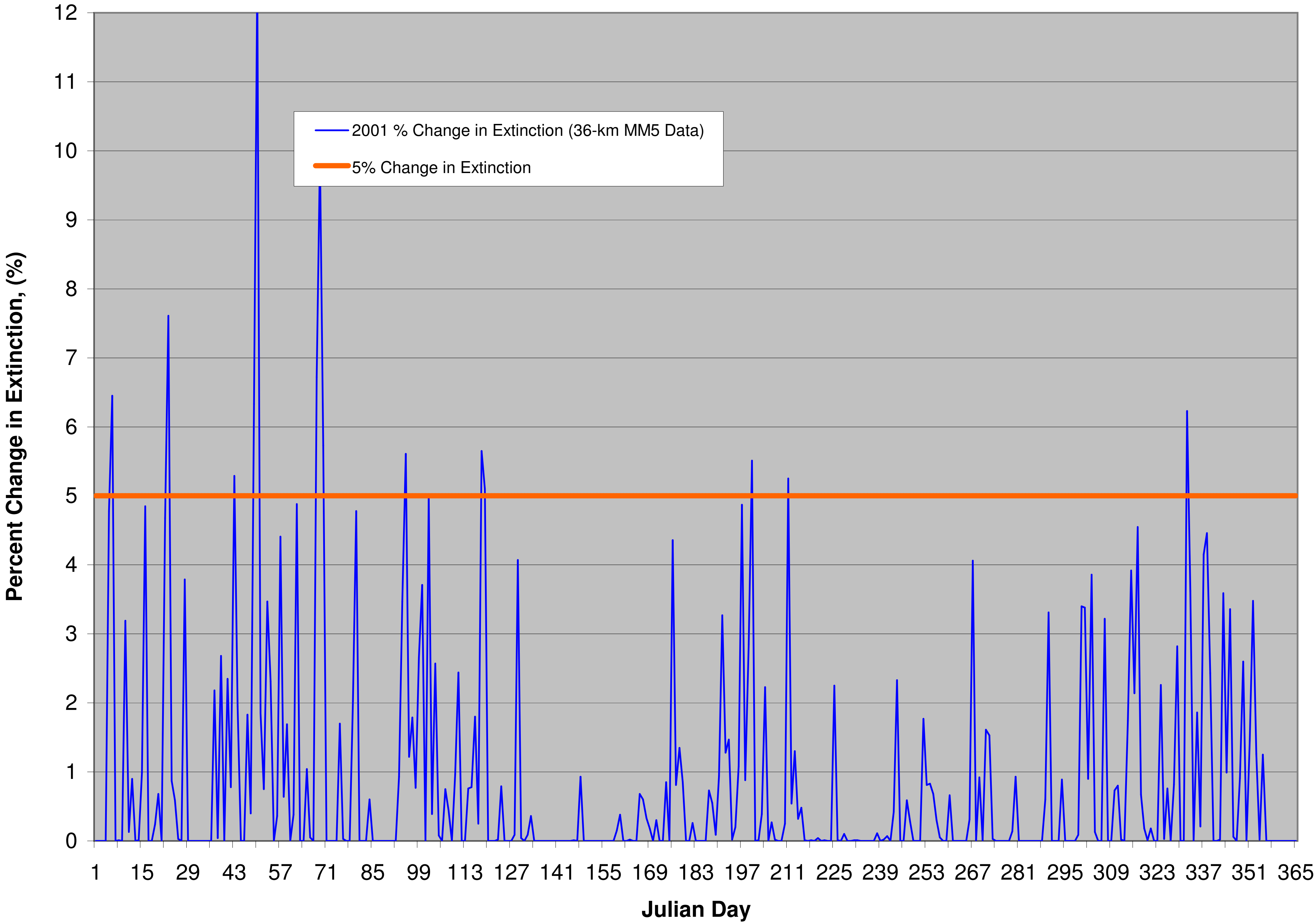
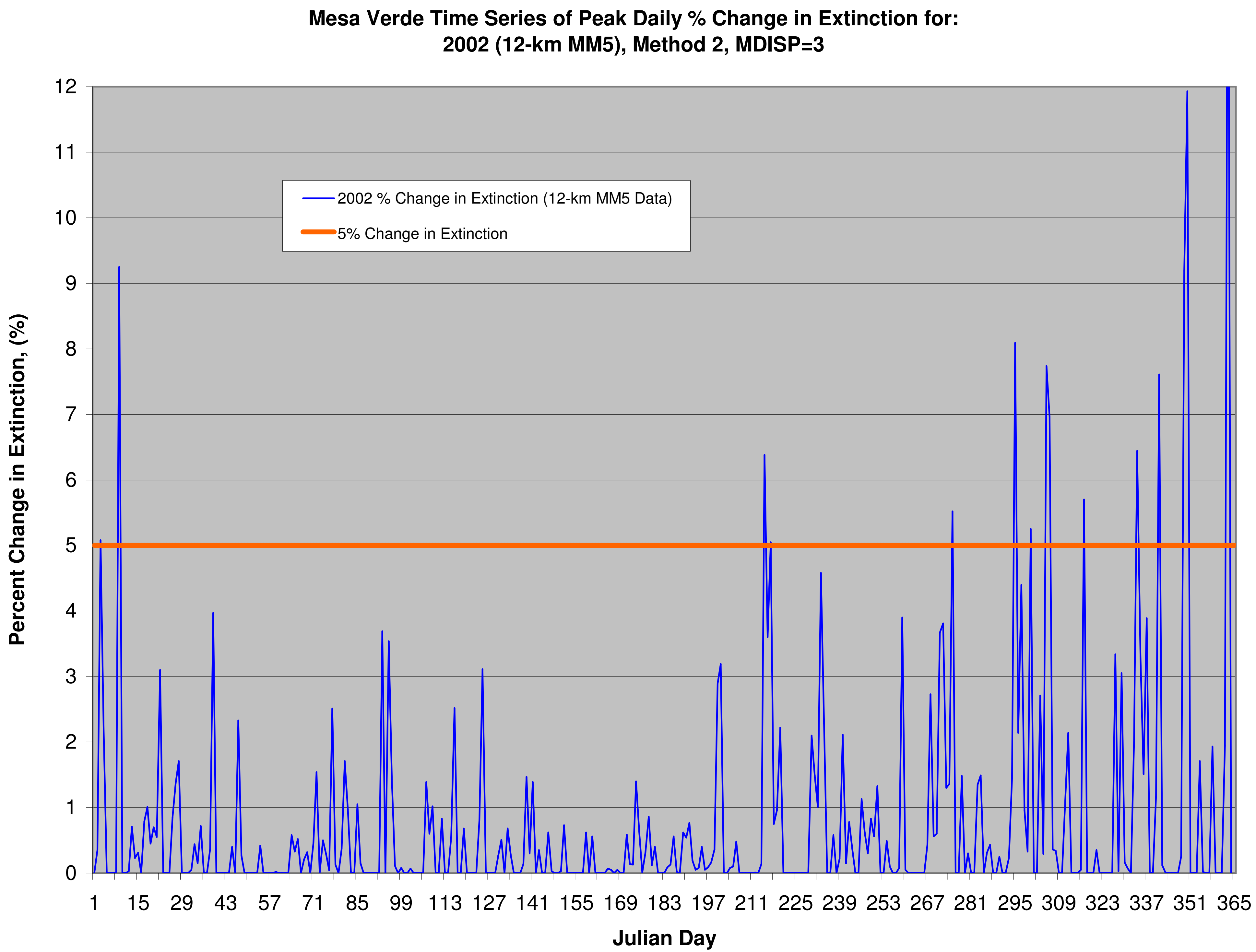
**Mesa Verde Time Series of Peak Daily % Change in Extinction for:
2001 (36-km MM5), Method 2, MDISP=3**




Mesa Verde Time Series of Peak Daily % Change in Extinction for:
2002 (12-km MM5), Method 2, MDISP=3
2002 % Change in Extinction (12-km MM5 Data)
5% Change in Extinction
Percent Change in Extinction, (%)
Julian Day
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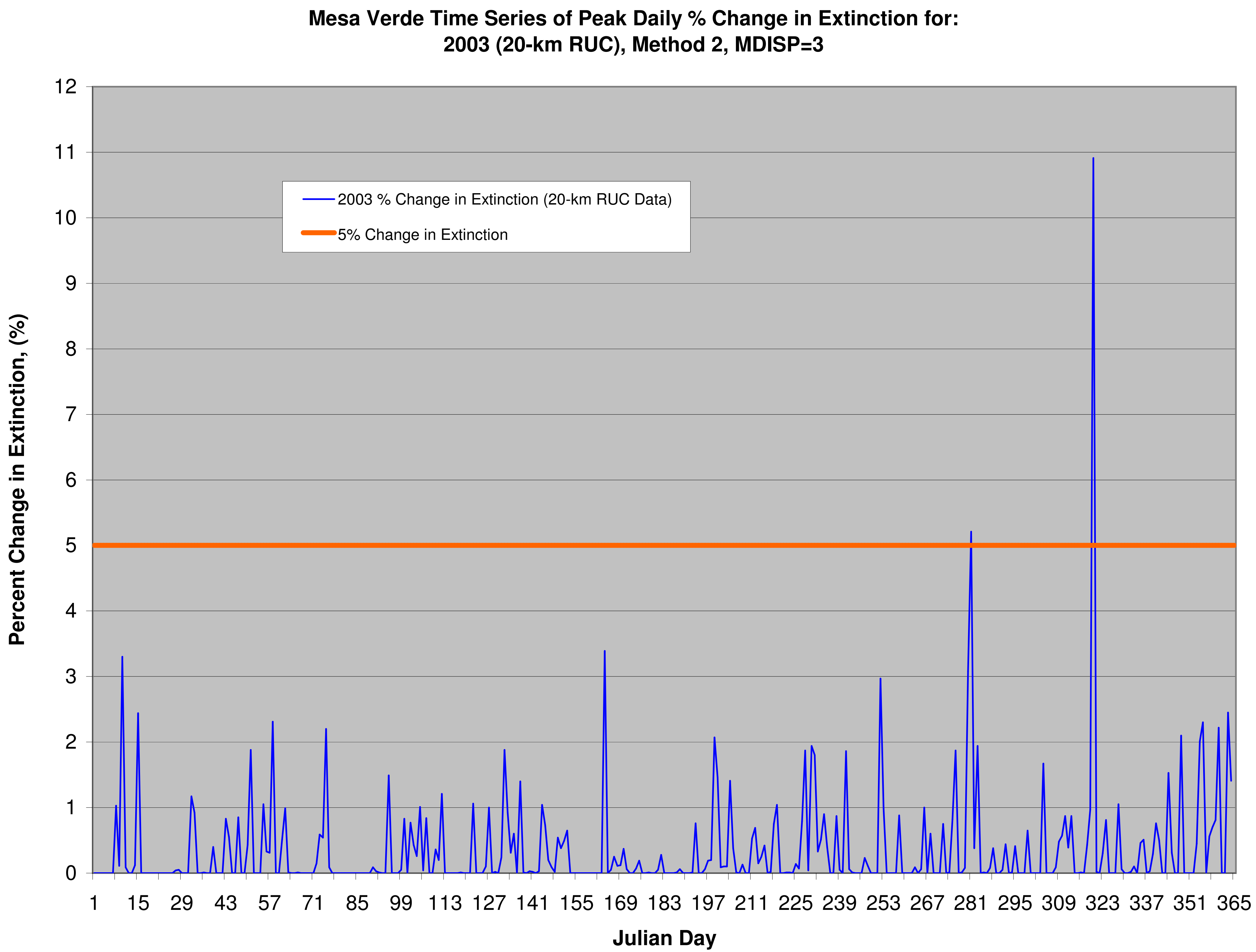

Mesa Verde Time Series of Peak Daily % Change in Extinction for:
2003 (20-km RUC), Method 2, MDISP=3
2003 % Change in Extinction (20-km RUC Data)
5% Change in Extinction
Percent Change in Extinction, (%)
Julian Day
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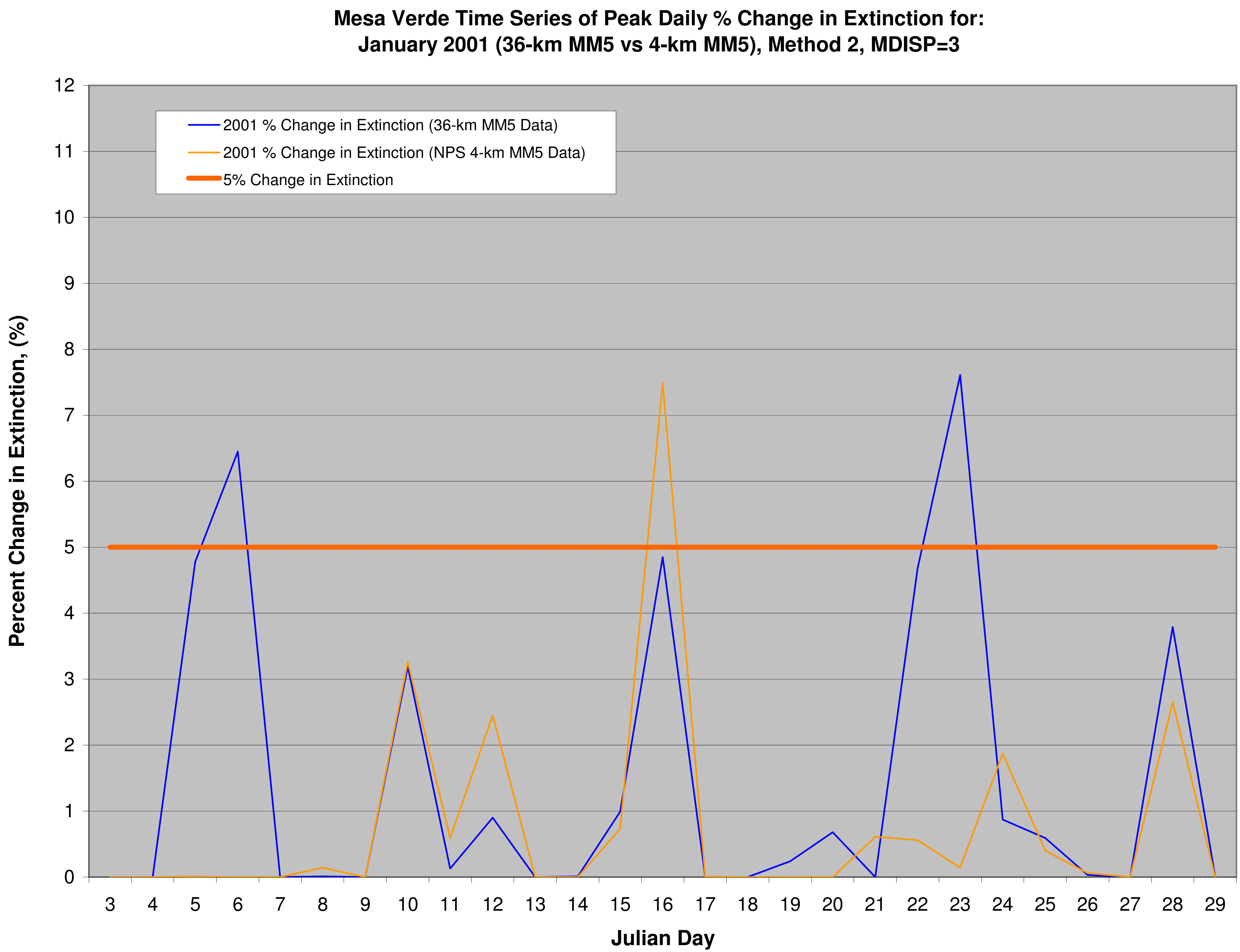

Mesa Verde Time Series of Peak Daily % Change in Extinction for:
January 2001 (36-km MM5 vs 4-km MM5), Method 2, MDISP=3
2001 % Change in Extinction (36-km MM5 Data)
2001 % Change in Extinction (NPS 4-km MM5 Data)
5% Change in Extinction
Percent Change in Extinction, (%)
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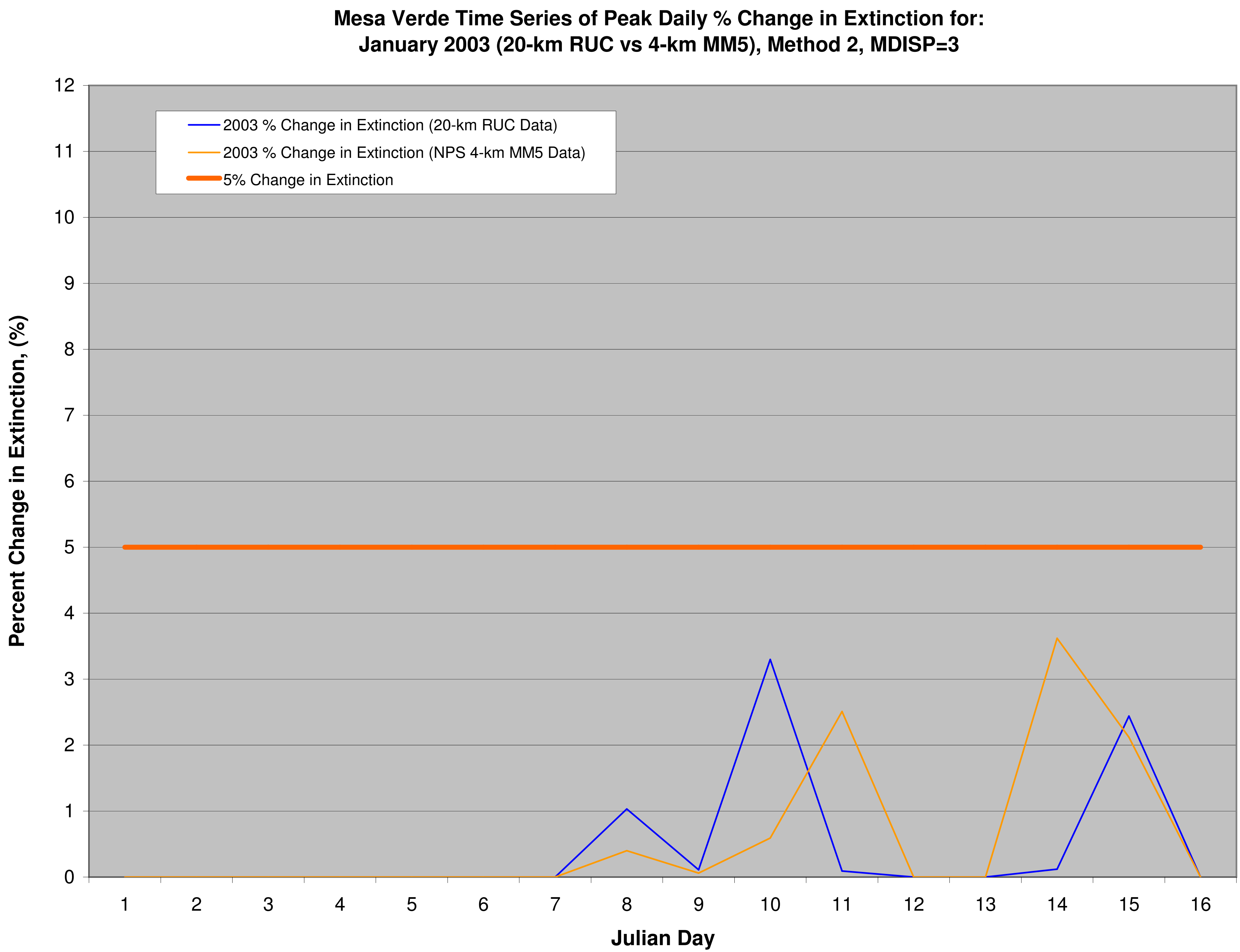
Julian Day


Mesa Verde Time Series of Peak Daily % Change in Extinction for:
January 2003 (20-km RUC vs 4-km MM5), Method 2, MDISP=3
2003 % Change in Extinction (20-km RUC Data)
2003 % Change in Extinction (NPS 4-km MM5 Data)
5% Change in Extinction
Percent Change in Extinction, (%)
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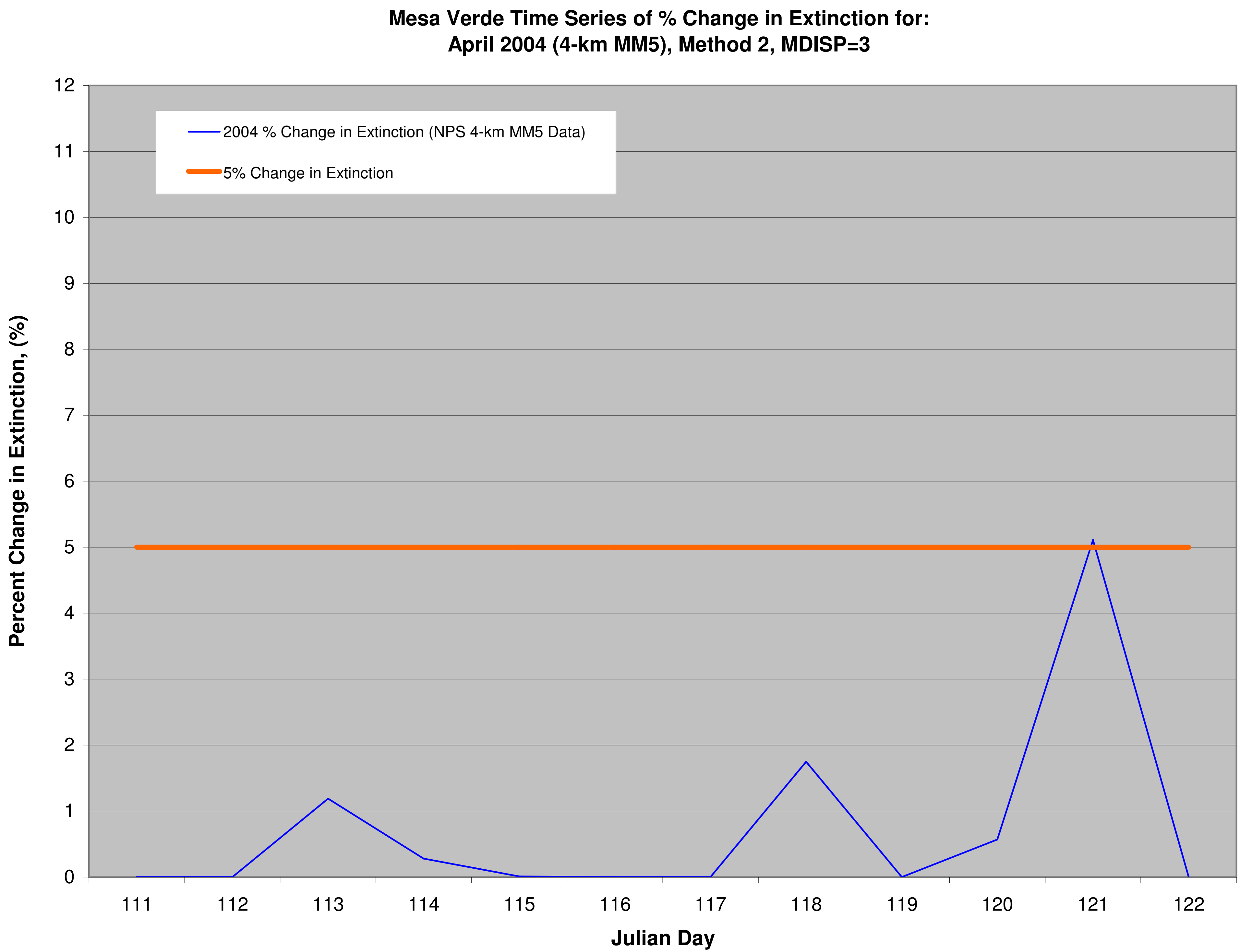

Mesa Verde Time Series of % Change in Extinction for:
April 2004 (4-km MM5), Method 2, MDISP=3
2004 % Change in Extinction (NPS 4-km MM5 Data)
5% Change in Extinction
Percent Change in Extinction, (%)
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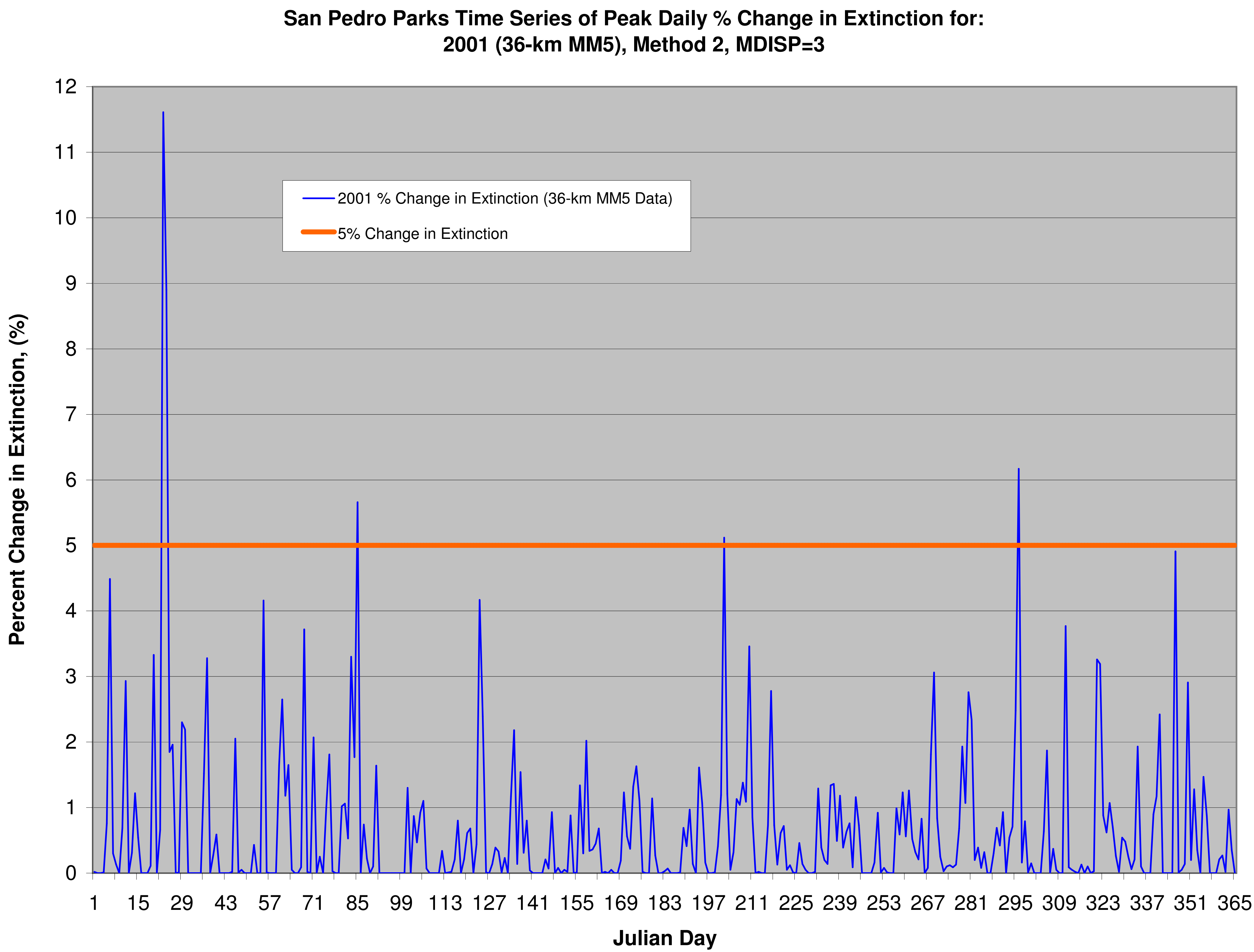
Julian Day



San Pedro Parks Time Series of Peak Daily % Change in Extinction for:
2001 (36-km MM5), Method 2, MDISP=3
2001 % Change in Extinction (36-km MM5 Data)
5% Change in Extinction
Percent Change in Extinction, (%)
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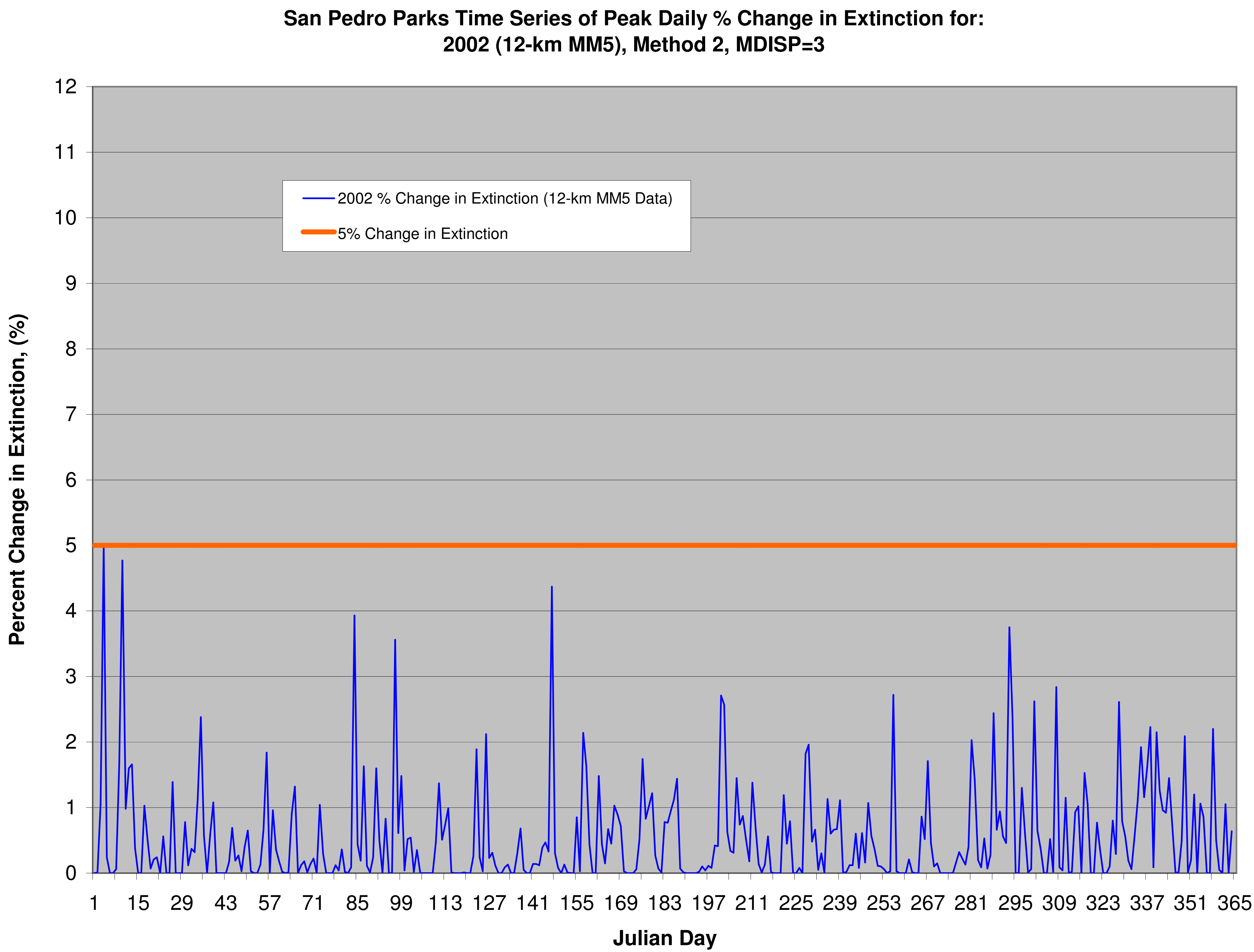

San Pedro Parks Time Series of Peak Daily % Change in Extinction for:
2002 (12-km MM5), Method 2, MDISP=3
2002 % Change in Extinction (12-km MM5 Data)
5% Change in Extinction
Percent Change in Extinction, (%)
Julian Day
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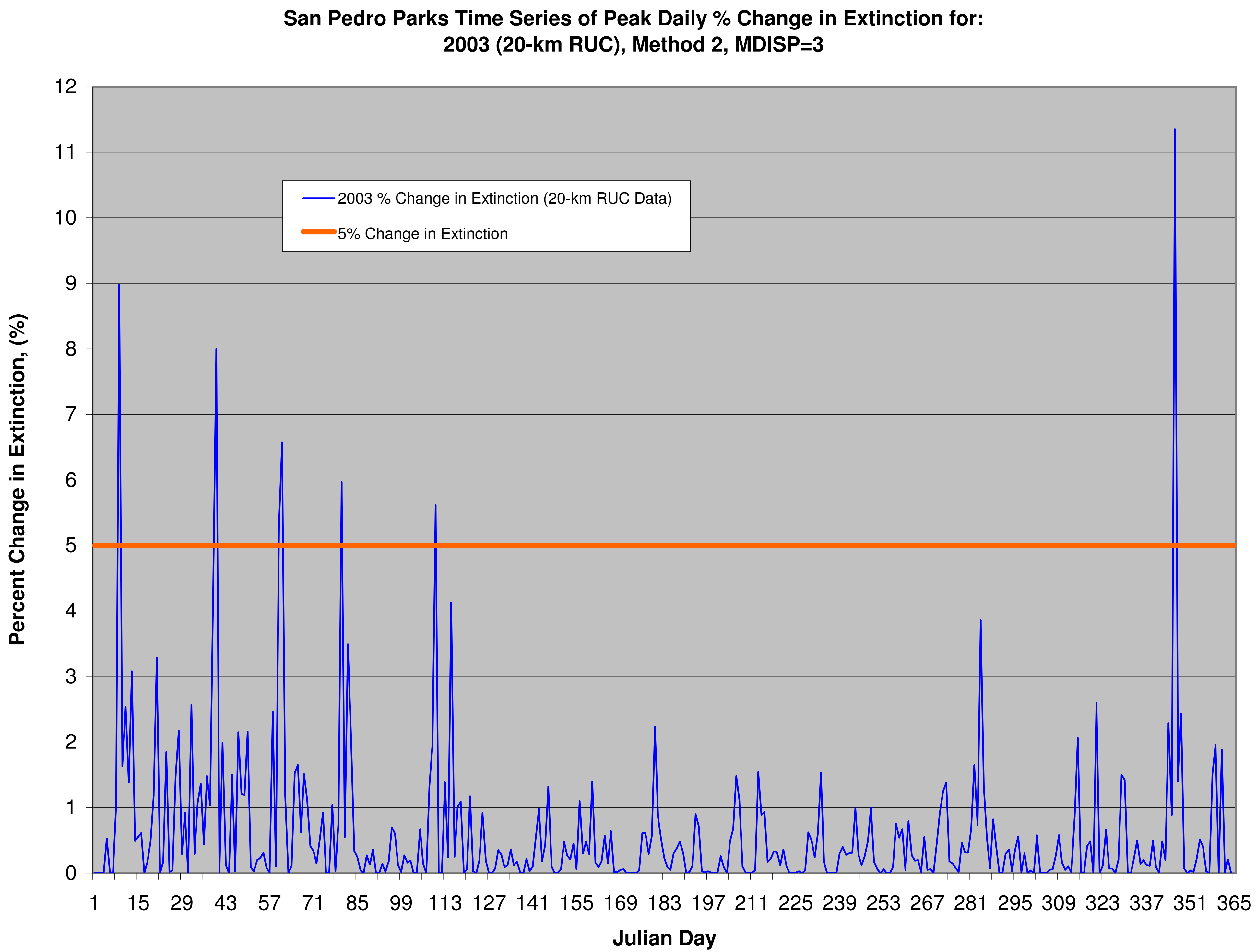
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2003 % Change in Extinction (20-km RUC Data)
5% Change in Extinction
Percent Change in Extinction, (%)
Julian Day
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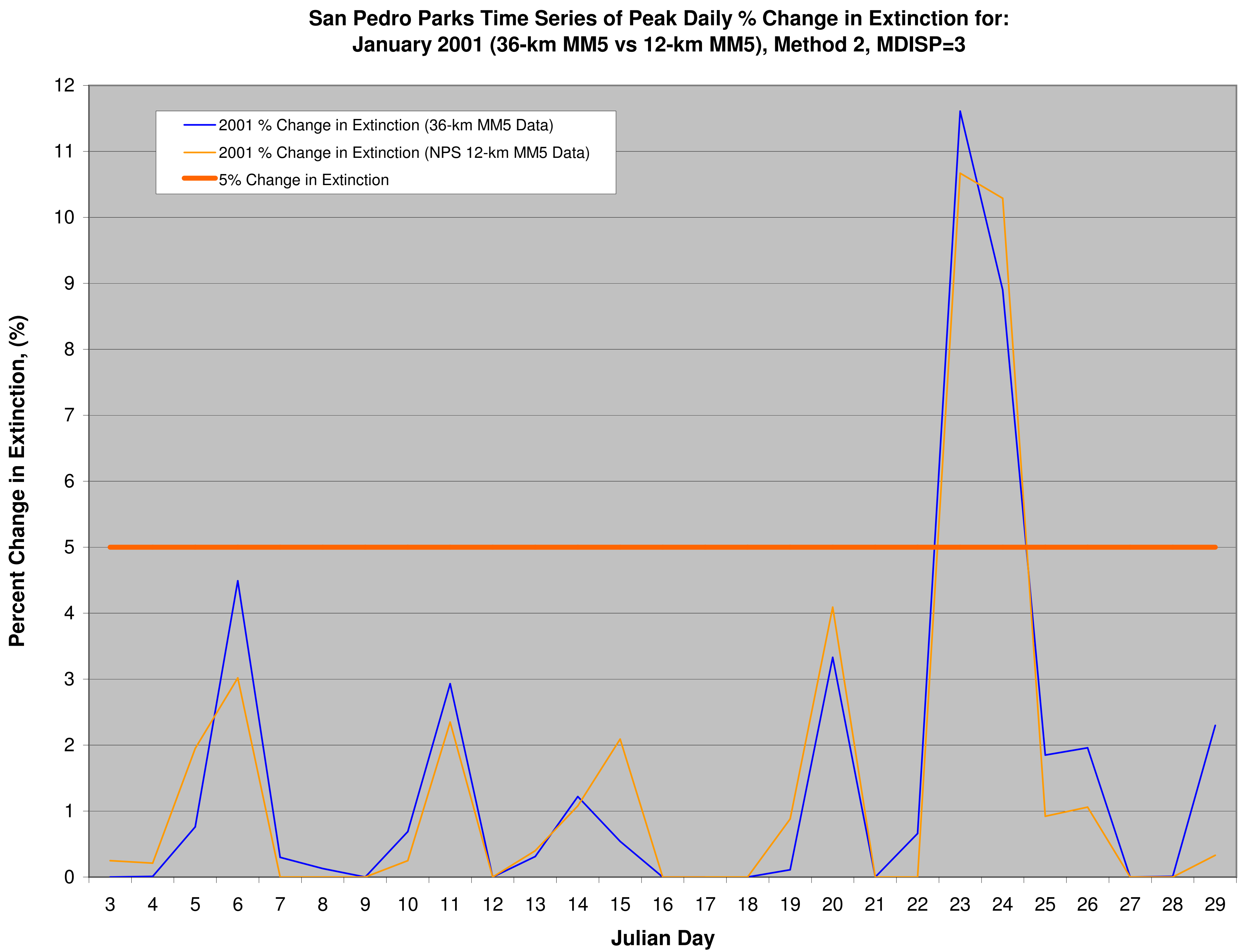
San Pedro Parks Time Series of Peak Daily % Change in Extinction for:
January 2001 (36-km MM5 vs 12-km MM5), Method 2, MDISP=3
2001 % Change in Extinction (36-km MM5 Data)
2001 % Change in Extinction (NPS 12-km MM5 Data)
5% Change in Extinction
Percent Change in Extinction, (%)
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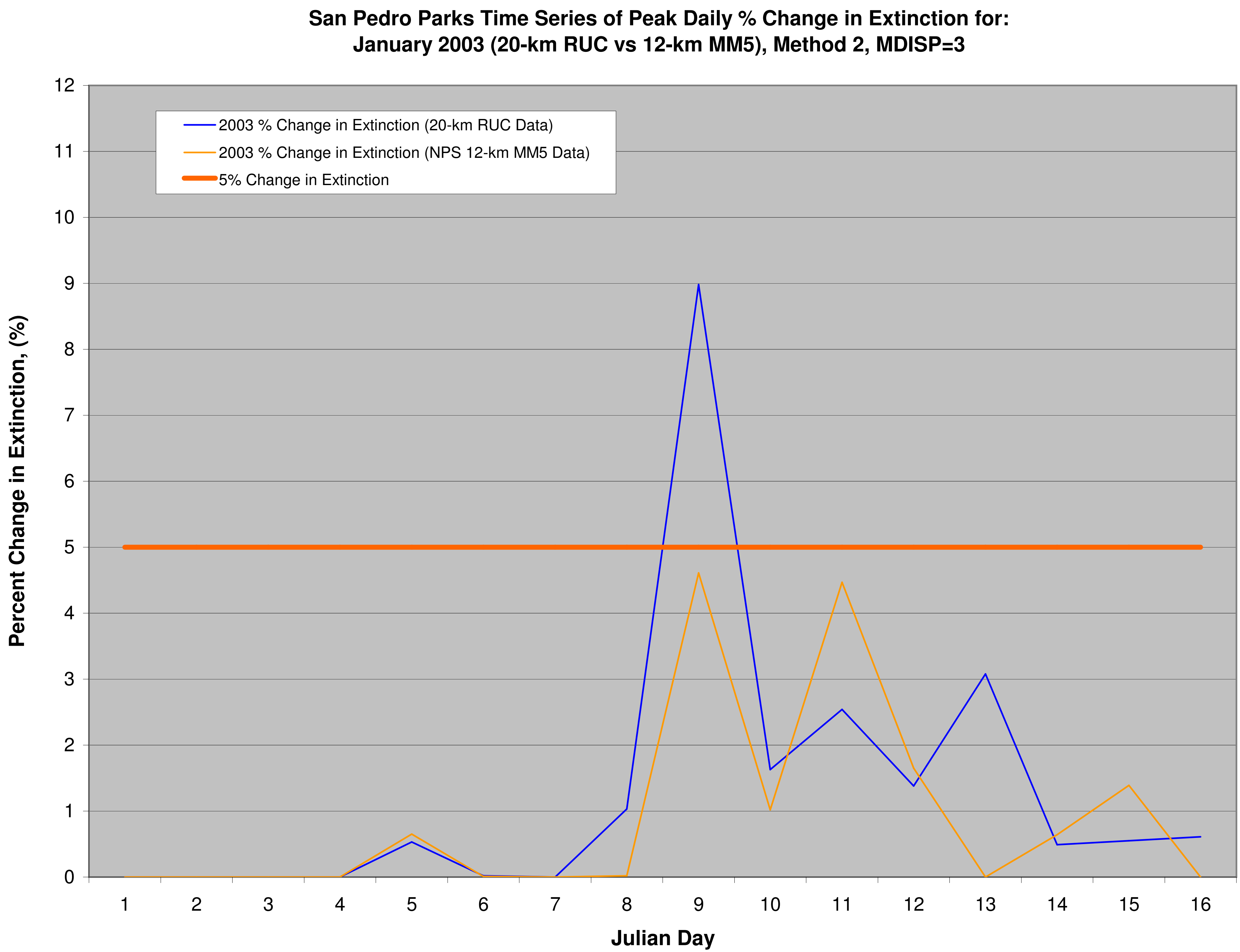
San Pedro Parks Time Series of Peak Daily % Change in Extinction for:
January 2003 (20-km RUC vs 12-km MM5), Method 2, MDISP=3
2003 % Change in Extinction (20-km RUC Data)
2003 % Change in Extinction (NPS 12-km MM5 Data)
5% Change in Extinction
Percent Change in Extinction, (%)
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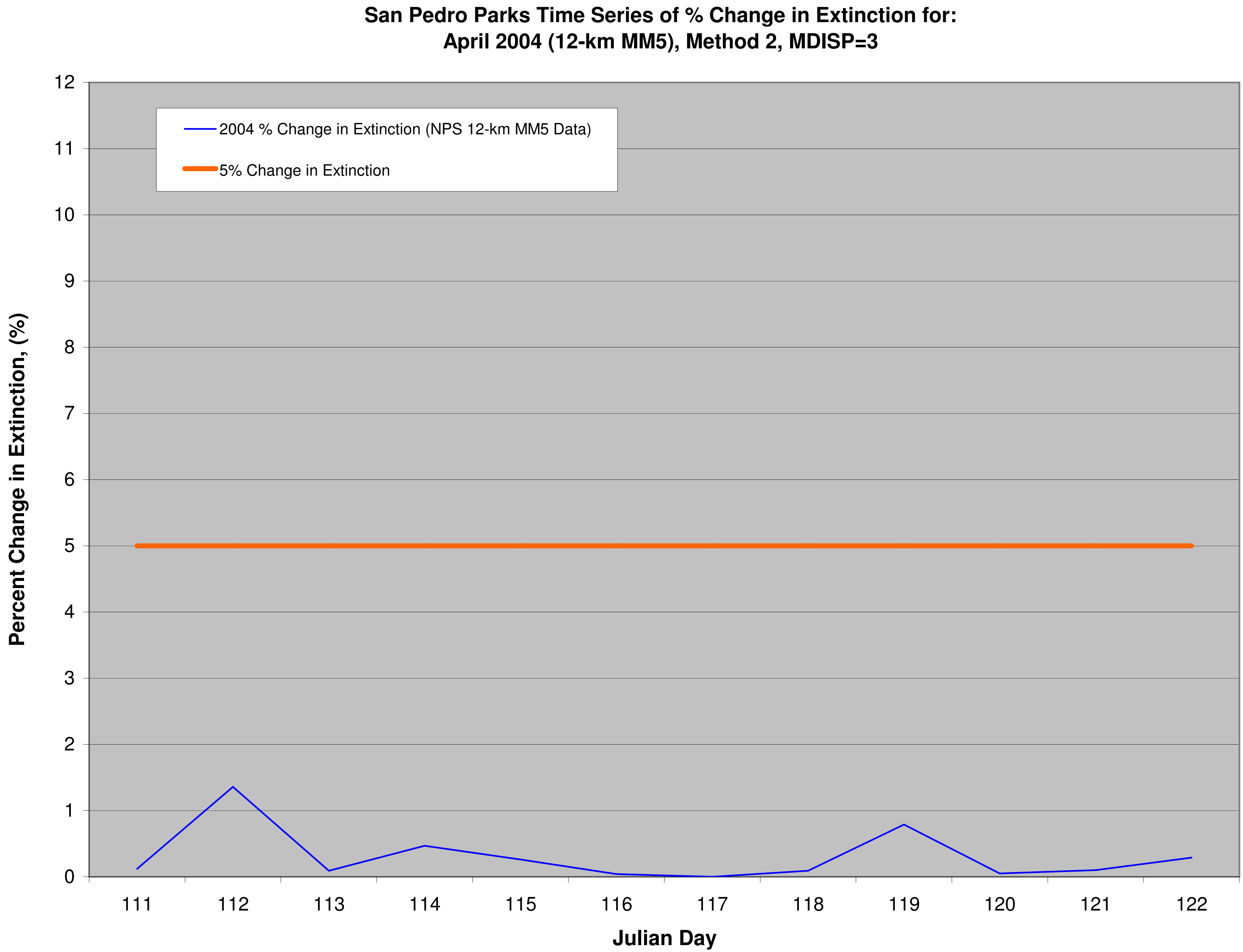
San Pedro Parks Time Series of % Change in Extinction for:
April 2004 (12-km MM5), Method 2, MDISP=3
2004 % Change in Extinction (NPS 12-km MM5 Data)
5% Change in Extinction
Percent Change in Extinction, (%)
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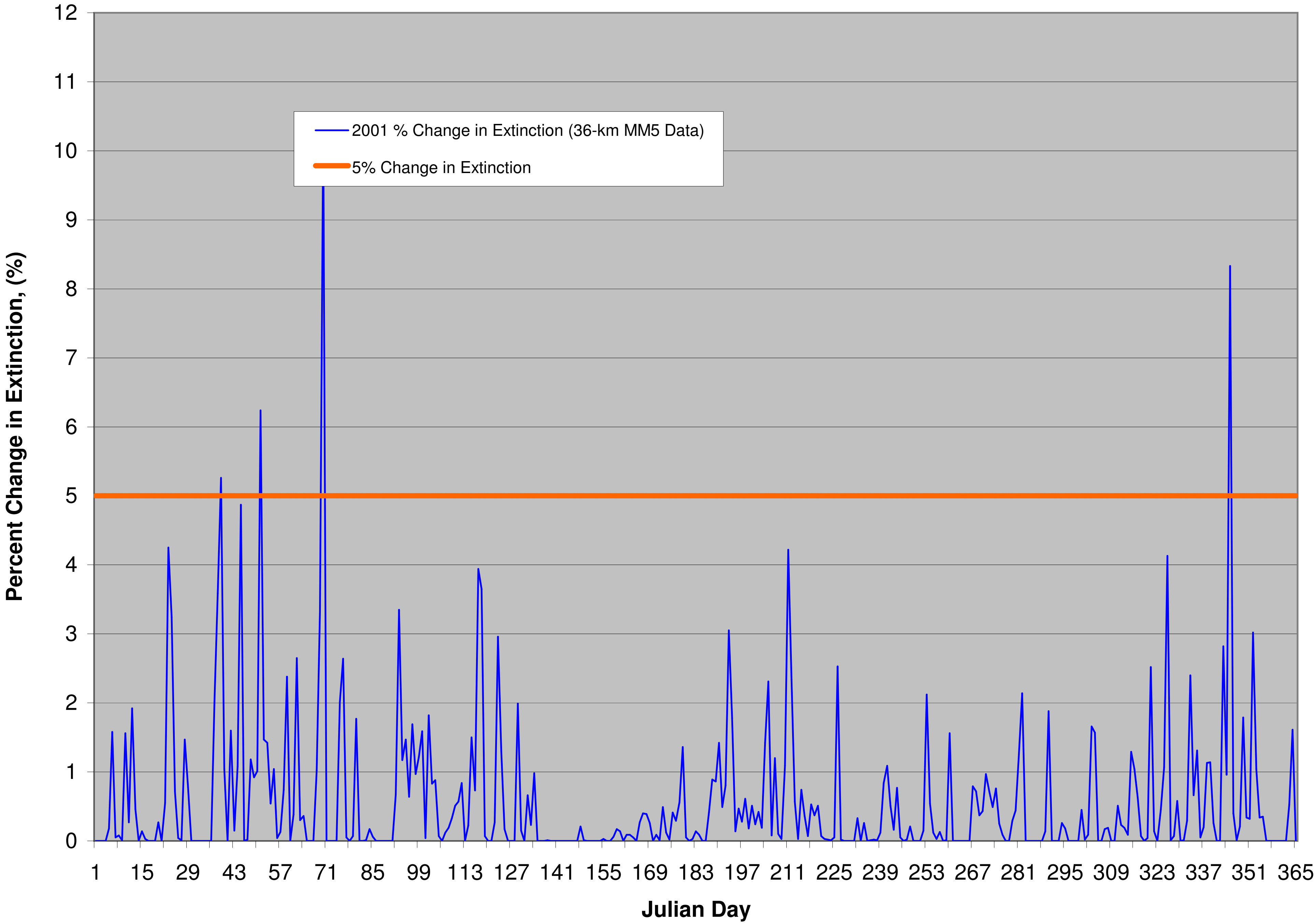
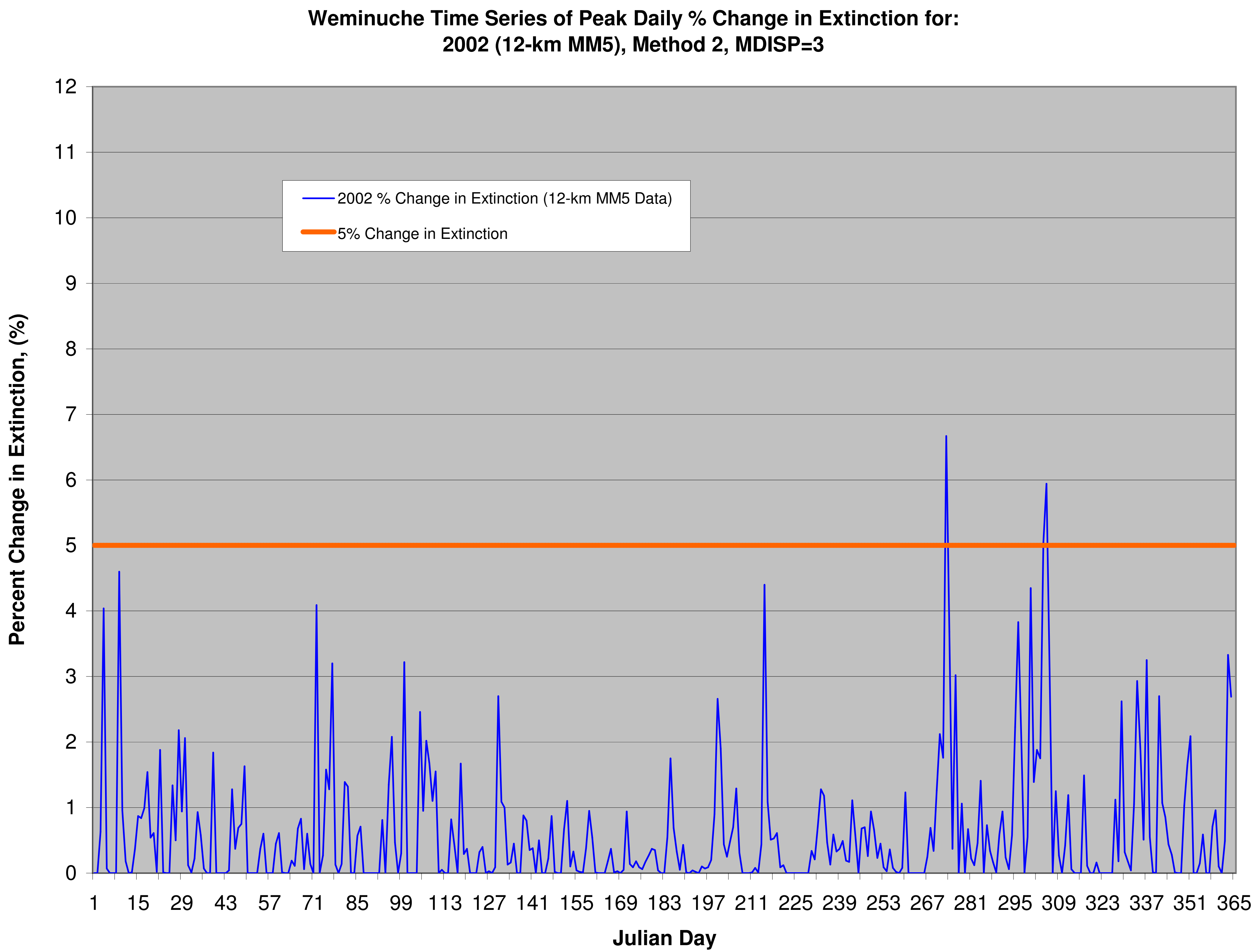
Julian Day

Weminuche Time Series of Peak Daily % Change in Extinction for: 2001 (36-km MM5), Method 2, MDISP=3

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2002 (12-km MM5), Method 2, MDISP=3
2002 % Change in Extinction (12-km MM5 Data)
5% Change in Extinction
Percent Change in Extinction, (%)
Julian Day
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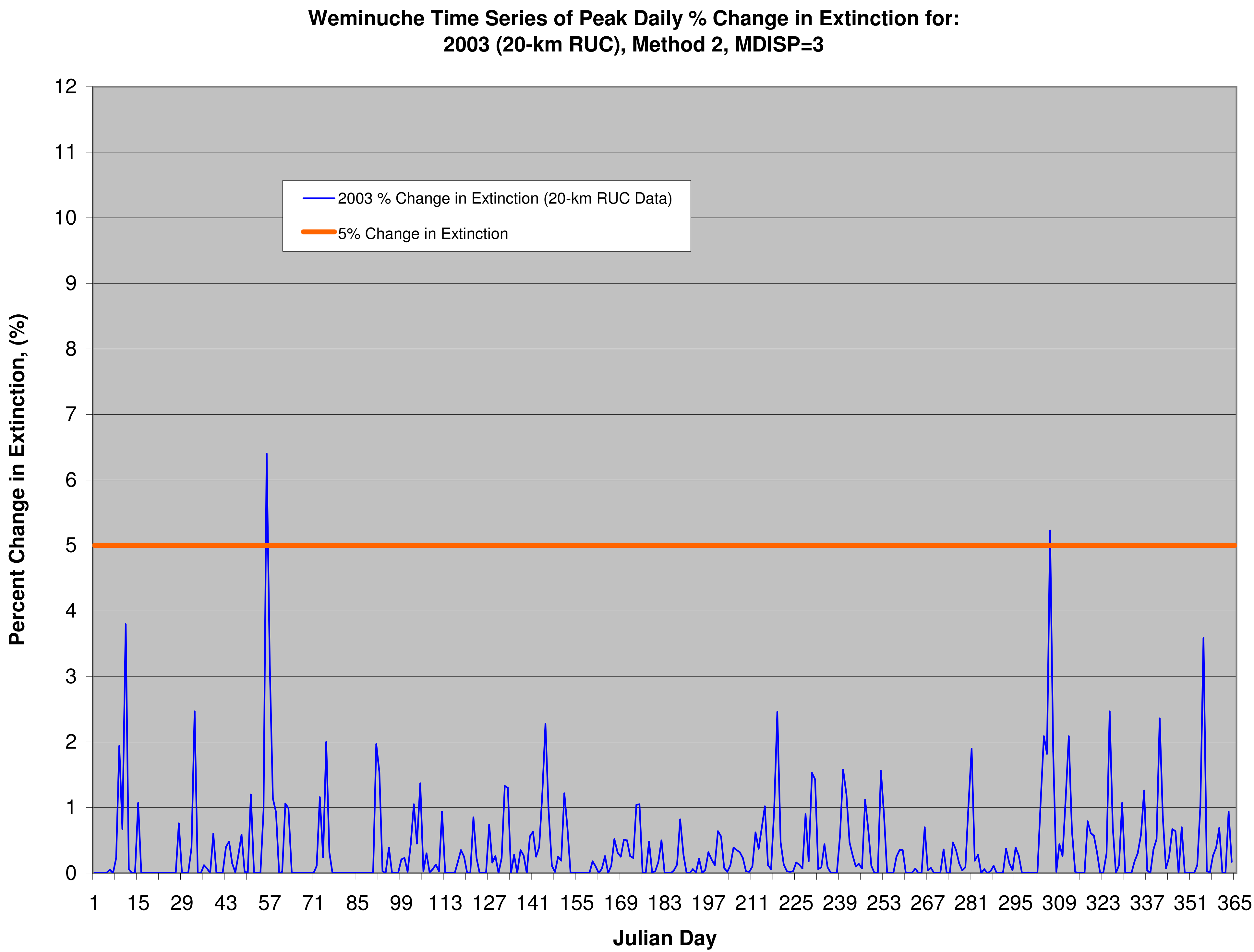

Weminuche Time Series of Peak Daily % Change in Extinction for:
2003 (20-km RUC), Method 2, MDISP=3
2003 % Change in Extinction (20-km RUC Data)
5% Change in Extinction
Percent Change in Extinction, (%)
Julian Day
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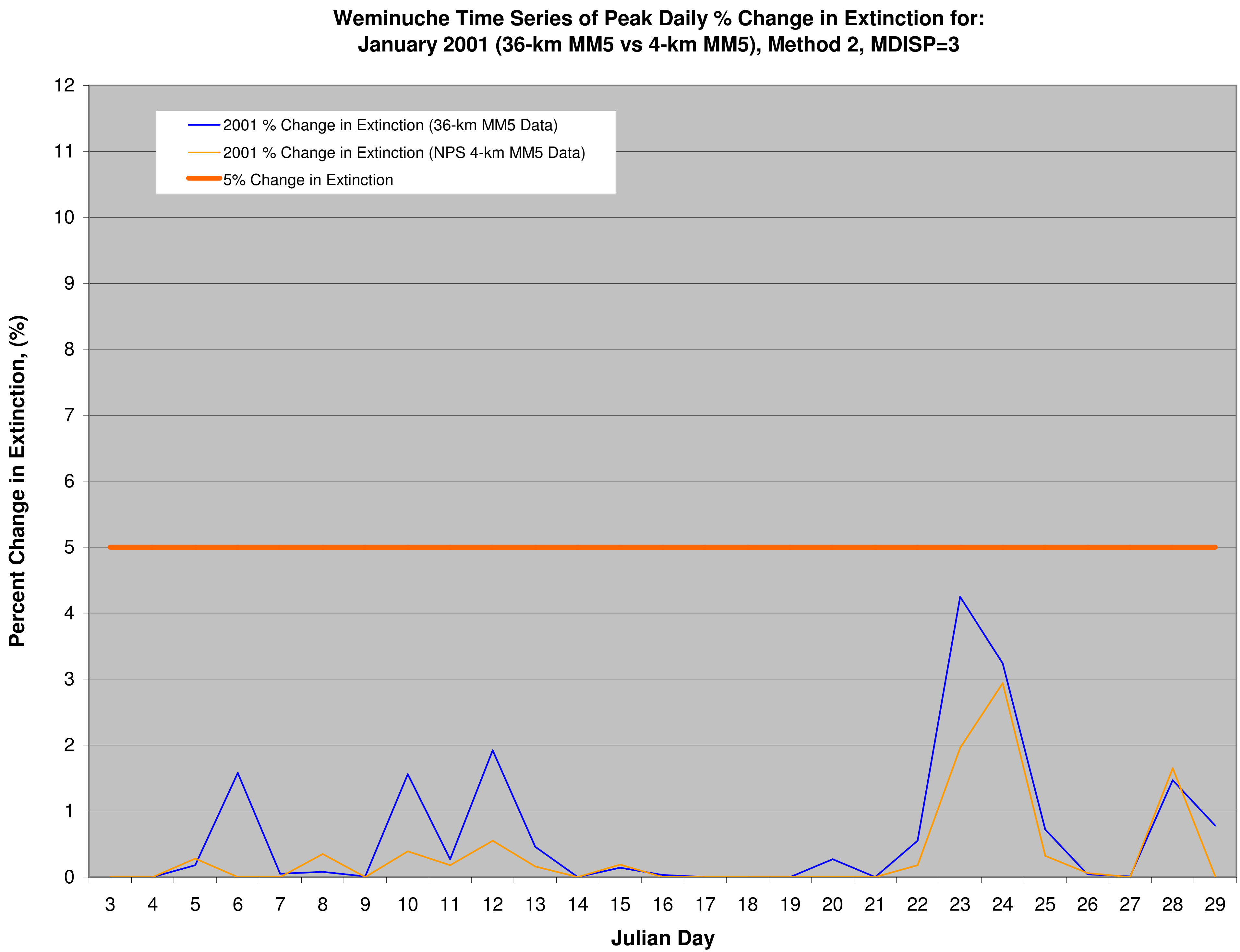

Weminuche Time Series of Peak Daily % Change in Extinction for:
January 2001 (36-km MM5 vs 4-km MM5), Method 2, MDISP=3
2001 % Change in Extinction (36-km MM5 Data)
2001 % Change in Extinction (NPS 4-km MM5 Data)
5% Change in Extinction
Percent Change in Extinction, (%)
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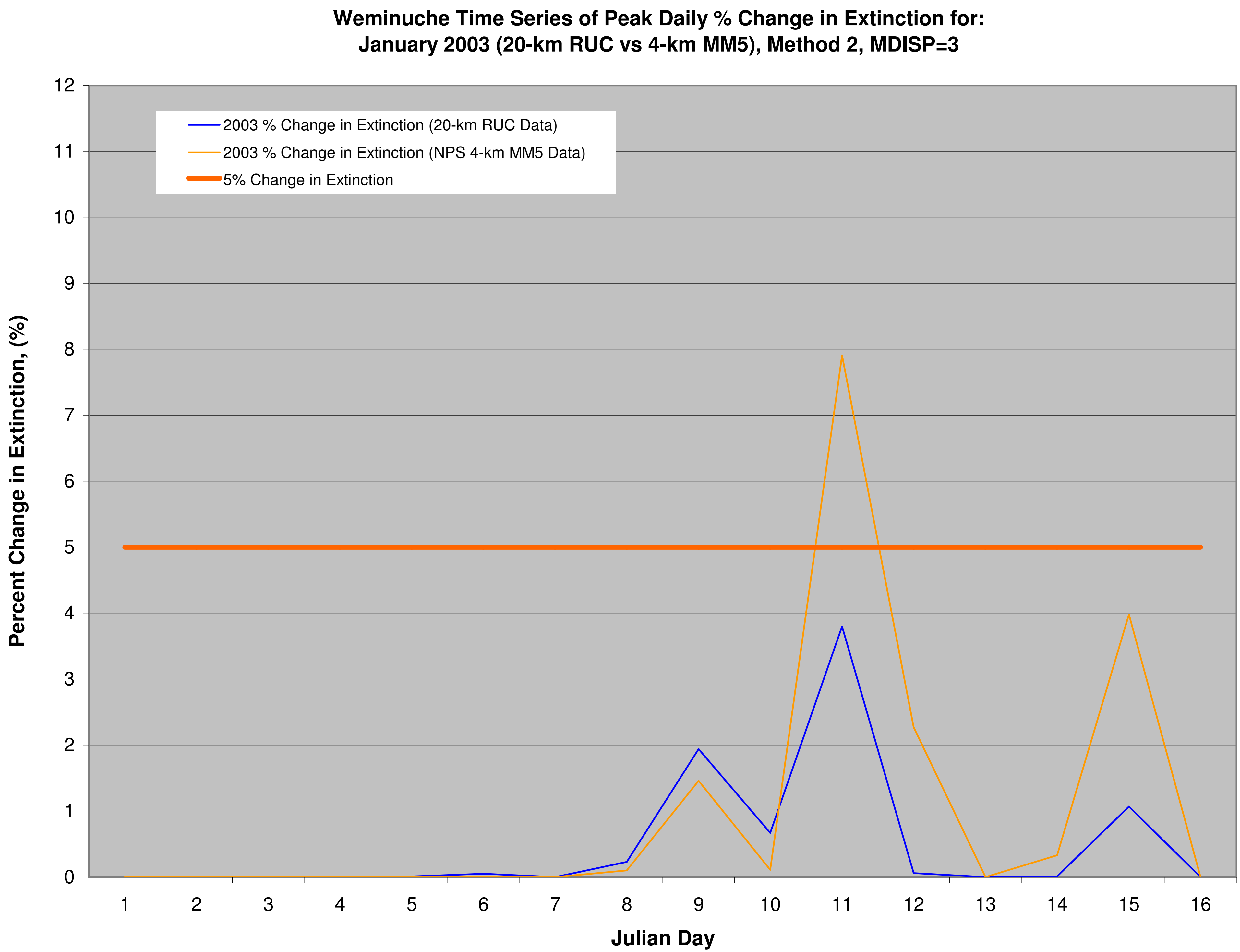
Weminuche Time Series of Peak Daily % Change in Extinction for:
January 2003 (20-km RUC vs 4-km MM5), Method 2, MDISP=3
2003 % Change in Extinction (20-km RUC Data)
2003 % Change in Extinction (NPS 4-km MM5 Data)
5% Change in Extinction
Percent Change in Extinction, (%)
Julian Day
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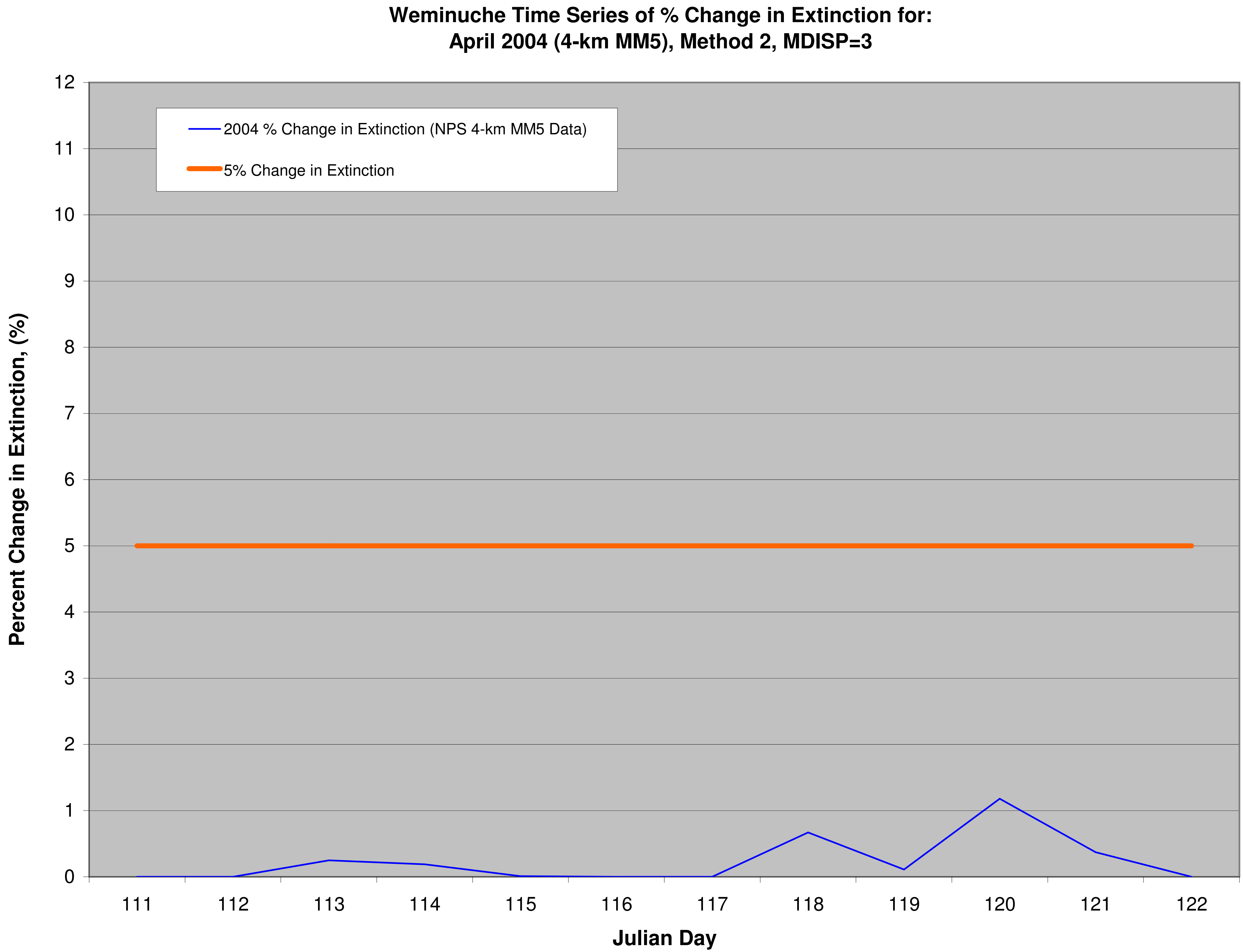

Weminuche Time Series of % Change in Extinction for:
April 2004 (4-km MM5), Method 2, MDISP=3
2004 % Change in Extinction (NPS 4-km MM5 Data)
5% Change in Extinction
Percent Change in Extinction, (%)
Julian Day
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Appendix C

Screening Methodology for Calculating ANC Change to High Elevation Lakes

Screening Methodology for Calculating ANC Change to High Elevation Lakes

USDA Forest Service Rocky Mountain Region
January, 2000

Introduction

The purpose of this screening methodology is provide a simplistic step-by-step process that can be used in New Source Review and NEPA(National Environmental Policy Act) processes to predict air pollution caused changes to the chemistry of sensitive lakes. Like other air quality related value screening methodologies this relatively conservative approach can be used to determine if a proposed source or group of sources either <u>do not</u> have the potential to impact to impact wilderness lakes or if it is appropriate to conduct a more complex but less conservative analysis.

This screening methodology uses a very simplistic set of equations to estimate how additions of sulfate and/or nitrate deposition from air pollution sources may cause a change in lake acid neutralizing capacity (ANC) from a monitored baseline. The methodology uses the following assumptions:

* The generation of acid neutralizing capacity in the watershed catchment to be analyzed is constant over time.

* All atmospheric deposition of sulfates and nitrates into the catchment enters the lake and neutralizes an equivalent amount of acid neutralizing capacity.

* The monitored baseline acid neutralizing capacity of the lake represents baseline acid neutralizing capacity of all of the water in the catchment.

These assumptions are meant to be conservative and, as such, do not incorporate aquatic ecosystem biogeochemistry. However, the methodology is appropriate to produce a relatively low cost screening level estimate of potential change in acid neutralizing capacity caused by a single pollution source or group of sources.

This approach is based on previous research papers by Fox, 1983 and Clayton, 1998, with changes suggested by Jim Clayton (personal communication) and John Turk (personal communication). In complex situations or where the screening results exceed Forest Service Limits of Acceptable Change (thresholds of concern) , a more sophisticated model such as the Model of Acidification of Groundwater in Catchments (MAGIC) should be run (Sullivan, 1995).

In order to assist in the use of this screening methodology the Forest Service will provide new source applicants or those persons conducting NEPA analysis with the following:

(1) A list of lakes for which potential change in acid neutralizing capacity should be calculated in the wilderness areas of concern, along with map coordinates for those lakes. In most cases, only one or two lakes per wilderness will be identified for analysis.

(2) Baseline lake acid neutralizing capacity as determined by monitored chemistry at the lakes of concern. Baseline acid neutralizing capacity values will usually be for the most sensitive (10% lowest) acid neutralizing capacity values from the lake so that predicted lake chemistry changes will consider sensitive (low acid neutralizing capacity) conditions that may occur on an episodic or seasonal basis.

(3) Estimates of watershed catchment size.

(4) Estimates of the average annual precipitation amounts for the catchment area.

For each analysis, the screening methodology will usually be applied twice:

* first to predict any change in acid neutralizing capacity from the proposed new source or proposed action by itself and,

* second to predict any change in acid neutralizing capacity from the cumulative total of all emissions sources that are included in the cumulative impact analysis (where applicable).

Process

Step 1: Computation of Deposition Flux from Annual N and S Emissions
The purpose of the following conversions is to produce outputs in both kg/ha/yr for reporting deposition (to evaluate aquatic and terrestrial effects) and in eq/m^2/yr to evaluate lake ANC change. Various models produce outputs in different formats. The following instructions will provide model outputs in the correct format to proceed with Step 2.

A.) **CALPUFF model output**: includes S from SO_2 and SO_4; and N from NO_2, HNO_3, and NO_3. Use the recommendations in IWAQM-Phase 2 (p 30-31) for calculation of N and S deposition in kg/ha/yr from the CALPUFF or CALPUFF-Screen modeling outputs. Ds will be the sum of all sulfur species and Dn will be the sum of all nitrogen species

OR

B) **ISCST or other approved model outputs**: some models may report all S outputs as SO_2 and all N outputs as NO_2. In this case, use the calculation below to estimate total (wet plus dry) deposition of S from SO_2 and N from NO_2.

$$Ds \text{ or } Dn = (X)(Vd)(R)(DEP)(Fc)$$

where: Ds = sulfur deposition flux (kg/ha/yr)
Dn = nitrogen deposition flux (kg/ha/yr)
X = pollutant concentration (ug/m^3)
Vd = deposition velocity of 0.005 m/sec for SO_2 or 0.05 m/sec for HNO_3 (ref. IWAQM Phase1)

R = Ratio of molecular weights of elements to convert from SO_2 to S and NO_2 to N (14/46 = .3 for NO_2; 32/64 = .5 for SO_2)
Molecular weight of H=1, N=14, O=16, S=32.
DEP = total deposition to dry deposition ratio (assume this equals 2.0 unless there is other info)
Fc = units conversion of ug/m^3 x m/sec to kg/ha/yr (315.4)

Step 2: Computation of Alkalinity Change from Annual Deposition Flux
This calculation provides an estimate of total equivalents of acid deposition over a year that either fall directly into the lake, or are deposited in the catchment that flows into the lake. This screening model assumes that all the equivalents of acidity eventually reach the lake, where they titrate the alkalinity.

Equation: % ANC change = [Hdep/ANC(o)] x 100
where:

ANC(o) = baseline ANC for entire lake catchment in eq = W x P x (1-Et) x A x (10,000m^2/ha) x (eq/10^6 ueq) x (10^3 liters/m^3)
A = baseline lake sample alkalinity in ueq/l
Hdep = acid deposition in eq = [H(s) + H(n)] x W x 10,000m^2/ha
Hs = sulfur deposition in eq/m^2/yr = Ds (kg/ha/yr) x (ha/10,000m^2) x (1000g/kg) x (eq/16g S)
Hn = nitrogen deposition in eq/m^2/yr = Dn (kg/ha/yr) x ha/10,000m^2) x (1000g/kg) x (eq/14g N)
W = watershed area in ha
P = average annual precipitation in meters
Et = fraction of the annual precipitation lost to evaporation and transpiration (assume Et = .33 unless better info available)
Ds = sulfur deposition in kg/ha/yr from all sulfur species
Dn = nitrogen deposition in kg/ha/yr from all nitrogen species

Example

Wilderness Name: Sangre de Cristo Wilderness
Lake Name : Lower Stout Lake
Lake Location: UTM coordinates 4,245,150 N and 422,300 E

Input Data:

A (baseline ANC)	= 165 ueq/l
Ds (sulfur deposition)	= 0.023 kg/ha/yr
Dn (nitrogen deposition)	= 0.112 kg/ha/yr
W (watershed area)	= 16 hectares
P (precipitation)	= 1.1 meters

Intermediate Values:

ANC(o)	= 19,457 eq

Hs	$= 0.000144\ eq/m^2$
Hn	$= 0.0008\ eq/m^2$
H(dep)	= 151.04 eq

% ANC change = [151.04/19,457)] x 100
= 0.78% change in Lower Stout Lake ANC projected from source specific sulfur and nitrogen deposition

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